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POCKET GOPHERS (THOMOMYS) OF THE LOWER COLORADO VALLEY

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In 1914, at the time the paper entitled "An account of the birds and mammals of the lower Colorado Valley" (Grinnell, Univ. Calif. Publ. Zool., vol. 12, pp. 51–294, 1914) was published, pocket gophers had been recorded from only two localities within this region. These represented two described races, one of which had been based upon a single specimen. Since that time, much collecting has been done in the general region, much additional material representative of the genus *Thomomys* has been gathered in several museums, and several additional races have been described.

The latest increments of pertinent specimens in the Museum of Vertebrate Zoology revealed so much new information regarding occurrence and variation that the preparation of the present paper was undertaken. These increments came from two main sources. In January and February, 1934, Miss Annie M. Alexander, Miss Louise Kellogg and Miss Mary M. Erickson collected widely in the Colorado Valley, in both California and Arizona. *Thomomys* was found in a number of new localities, and the population samples from 3 of these each constitutes the basis for a new name, as proposed in the present connection. During the same two months, a Museum party in charge of Dr. Seth B. Benson collected mammals, including some pocket gophers, in the southern tip of Nevada south to, and also just across, the boundary of California.

It is the purpose of the present writers to report upon the sum total of the appropriate materials now accumulated in the Museum of Vertebrate Zoology, to describe the races which appear to be new, to offer, where deemed necessary, descriptive comment concerning races previously named, and to discuss briefly, from the standpoint of topography, relationships of forms. The forms here included are as follows:

Thomomys perpallidus albatus Grinnell.
Thomomys perpallidus lucidus Hall.

Thomomys perpallidus phasma Goldman.
Thomomys perpallidus depauperatus, new subspecies.
Thomomys perpallidus riparius, new subspecies.

FIG. 1. Map of lower Colorado River valley, showing localities whence specimens of pocket gopher have been examined by the authors. Assumed ranges of subspecies and species outlined brokenly and numbered as follows: 1, *Thomomys perpallidus albatus;* 2, *T. p. lucidus;* 3, *T. p. phasma;* 4, *T. p. depauperatus;* 5, *T. p. riparius;* 6, *T. p. centralis;* 7, *T. chrysonotus;* 8, *T. harquahalae;* 9, *T. suboles.*

Thomomys perpallidus centralis Hall.
Thomomys chrysonotus Grinnell. [*Thomomys fulvus flavidus* Goldman is synonymized here.]
Thomomys harquahalae, new species.
Thomomys suboles Goldman.

Thomomys perpallidus albatus Grinnell

The Museum of Vertebrate Zoology contains specimens referable to this race of pocket gopher from the following localities (see map). *Imperial County, California:* Bard (10); Colorado River near Pilot Knob (8); Old Fort Yuma (11); Kane Springs (1); Salt Creek (8); Salton Lake [Sea, southwest side] (6). *San Diego County, California:* Carrizo Creek (3). *Riverside County, California:* near Thermal (2). *Yuma County, Arizona:* 4 miles south of Gadsden (5); 1 mile north of San Luis (6); 5 miles southeast of Yuma (12). *Lower California, Mexico:* Alamo River, 20 miles southwest of Pilot Knob (6); 5 miles east of Cerro Prieto (10); 7 miles east of Cerro Prieto (1); Colorado River, 20 miles south of Pilot Knob (13); Imperial Canal, 11 miles east of Mexicali (10). Total, 112.

Critical examination of the above designated series of specimens and analysis of the characters shown lead us to conclude that in the vicinity of Yuma the race *albatus* occurs on both sides of the Colorado River. The specimens from the east side of the river are smaller in general size, but their skulls are much more like those of typical *albatus* than of *T. p. phasma* Goldman. Some individuals show an approach in color toward *phasma* in that they are darker mid-dorsally. The majority, however, are quite as pale as *albatus* from the western side of the river, and all are paler and less pinkish than *phasma*.

A possible interpretation of this state of affairs is that a population of *albatus* at a not too remote time became transferred to the Arizona side by one of the shifts in the river (*cf.* Goldman, Jour. Wash. Acad. Sci., vol. 21, p. 416, 1931)—granting that the *albatus* stock came to the edge of the river from the California side. Interbreeding with *phasma* might have followed, with a resultant selection favoring *albatus*-like progeny. This would not, however, explain why the skulls of all are *albatus*-like.

Thomomys p. albatus is a form in which more or less isolated populations, each remarkably uniform in itself, differ slightly from other nearby populations. The differences here involved, however, are too small to be of taxonomic value and are only perceptible under close examination. This race seems to be naturally restricted in habitat to the semi-moist silt flats wherever a growth of *Distichlis* and *Atriplex* furnishes sufficient food. It probably is not found in the hard, dry, and gravelly ground of the desert mesa. With the agricultural "reclamation" of the Imperial Valley and the adjacent parts of Lower California this gopher has taken advantage of the favorable habitat thus artificially extended. Although animals under these conditions may be fatter, heavier, and more prolific, their general size and their skull characters seem to be but little affected. Some of the largest and most extreme individuals come from wild land.

Thomomys perpallidus lucidus Hall

This recently named race from Las Palmas Cañon, west side of Laguna Salada, Lower California, Mexico, is known from only two specimens, one of them immature. The valley in which lies the lake is well separated from the valley of the Colorado on the east, but is less completely separated from the Colorado Desert to the north. It is open to the delta on the southeast by a narrow pass. The habitat of *lucidus* is thus not completely isolated from the area occupied by *albatus*.

The cranial characters given by Hall (Proc. Biol. Soc. Wash., vol. 45, pp. 67–70, 1932) are in general outside of the range of variability exhibited in our series of *albatus* and are of a nature not explainable by mere difference in general size. Specimens of *albatus* of similar body length, from Gadsden, Yuma County, Arizona, show that *lucidus* has in fact less widely spreading zygomatic arches, narrower mastoid width, and more slender rostrum. More specimens certainly are needed to establish the tenability of this race; but the available evidence seems to justify its recognition.

Thomomys perpallidus phasma Goldman

Two localities, from which all specimens are typical of this race, were visited by the recent Alexander expedition. *Yuma County, Arizona:* Tule Tank, the type locality (2), and Wellton (3).

One of the two topotypes agrees closely in color with Goldman's description (Proc. Biol. Soc. Wash., vol. 46, pp. 72–73, 1933). The other specimen is in shorter, less fluffy pelage and, although taken on the same day as the other, seems to be in summer coat. It is decidedly grayish in appearance, darkest mid-dorsally. The specimens from Wellton are very similar to this, but one of them is even darker, because of the greater extension of the terminal color bands on the hairs of the back. The darker mid-dorsal area thus formed indicates relationships with races whose ranges lie farther east. The same is true of the contrasting summer and winter pelages.

The skulls of the topotypes of *phasma* agree fairly well with the description given by Goldman, but the nasals are not shorter than in skulls of *albatus* of the same size. The base of the rostrum has a tendency to bulge.

The material examined indicates that the range of *Thomomys p. phasma* is probably restricted to the floor of the Lechuguilla and Tule deserts. Specimens from Bates Well appear recognizably different, as do those from the Tinajas Altas Mountains. Habitat is given in the collectors' notebooks, and by Goldman, as arid desert mesas along margins of washes; soil gravelly; associated with mesquite and catsclaw.

Thomomys perpallidus depauperatus, new subspecies

Type.—Adult female, skin and skull; no. 62079, Mus. Vert. Zool.; east base Tinajas Altas Mountains, 7 miles south of Raven Butte, 1150 feet altitude, Yuma County, Arizona; collected by Annie M. Alexander; orig. no. 2704; January 17, 1934.

Diagnosis.—A small, pale-colored gopher. General coloration pinkish buff, overlaid with dusky, darker mid-dorsally (as in *phasma*). Skull smooth and light; zygomatic arches relatively wide-spreading, with sides parallel and relatively short, squarish anteriorly (that is, angle between rostrum and anterior root of zygomatic arch less obtuse than in *phasma*); rostrum narrow, extremely short; nasals broad and truncate posteriorly, with sides nearly parallel; premaxillary tongues extending only slightly behind nasals, broad to their posterior ends, and truncate. Incisors very slender, notably incurved; molars relatively large.

Measurements.—See table, p. 8.

Distribution.—Known only from the type locality.

Remarks.—Externally similar to *phasma*. The small size and other characters as given above separate this race from *phasma* and other adjacent forms.

Four specimens, all females, from the type locality have been examined. The type is a "conservative" specimen; the others are more extreme in differentiation, but they agree fairly closely among themselves and with the type. The chief variability is in general size.

It is with considerable dubiety that we propose to recognize this race based on cranial characters alone and located at so little distance from the type locality of *phasma*. The cranial characters, however, are quite distinctive. It may also be said in favor of recognizing *depauperatus*, that the woodrats and rock mice from this locality are externally different from those at Tule Tank.

The specimens of this race were taken in gravelly soil along margins of washes, associated with mesquite and catsclaw.

Thomomys perpallidus riparius, new subspecies

Type.—Adult female, skin and skull; no. 61985, Mus. Vert. Zool.; Blythe, Riverside County, California; collected by Annie M. Alexander; orig. no. 2831; February 20, 1934.

Diagnosis.—A large, pale-colored gopher, evidently nearest to *Thomomys p. albatus.* Upperparts pale ochraceous buff tinted with cinnamon; lightly overlaid on back by dusky; top of head and face mixed dusky and whitish; ears brown-black; ear patches well marked, blackish; under parts rather sharply set off from upperparts, hairs whitish, with considerable plumbeous at bases except in inguinal region; feet, tail, and insides of pouches, white. Ear small. Skull heavy, rugose; zygomatic arches widely spreading, squarish; rostrum heavy; tympanic bullae relatively little inflated compared with all adjacent races; mastoid bullae little inflated and little exposed posteriorly; occiput sloping, rugose, but area of attachment of suboccipital muscles not sharply outlined.

Measurements.—See table, p. 8.

Distribution.—Known only from alluvial soil in the vicinity of Blythe, but probably found generally through the Palo Verde Valley. The description is based on 9 adult and 3 immature specimens collected by Annie M. Alexander and Louise Kellogg, all in the near vicinity of Blythe.

Comparisons.—Externally *Thomomys p. riparius* is most like *T. p. albatus*; size similar; general coloration similar but less yellowish, more dusky, especially on the head; ear patches larger and much darker. Skull as in *albatus* but bullae much less inflated; posterolateral angle of zygoma more sharply developed; middle of zygoma more emarginate; occiput more rugose.

Color much paler, less ochraceous, than in *chrysonotus.* Skull shorter, rostrum heavier; nasals shorter; bullae less inflated; zygomatic plate more emarginate below. Paler and less grayish than topotypical *perpallidus*; greater difference in size between sexes. Skull with broader brain-case; zygomata wider spreading; rostrum stouter, more angular; nasals wider and more truncate posteriorly; mastoid bullae much less inflated. Incisors less incurved. Much paler than average *centralis*; skull similar, but occiput less perpendicularly truncate; area of attachment of suboccipital muscles less sharply restricted; nasals truncate behind; mastoid bullae uniformly little inflated. Incisors broader, slightly less incurved. Little comparison is needed with *Thomomys providentialis* Grinnell, since *riparius* is much larger, with more massive and more angular skull.

Remarks.—The Palo Verde Valley is similar in general type of soil and flora to the Imperial Valley where *albatus* is found, but it is separated from the latter by barriers of terrain unsuited to this type of gopher. Skull characters indicate that *riparius* is closely related to *centralis* and that it may be considered as a connecting link between this race and *albatus*; its closer color resemblance to the latter may be partly the result of convergence.

Thomomys perpallidus centralis Hall

Specimens referable to this race have been collected in the Colorado River Valley in the following localities. *Clark County, Nevada:* Durban ranch, 14 miles east of Searchlight (15); one-half mile north of the California boundary (21). *San Bernardino County, California:* one-quarter mile south of the Nevada boundary (1). Total 37.

The series from the two localities mentioned are not significantly different from one another, and each population is extremely variable. We are inclined to consider them both as showing intergradation with *T. p. riparius* to the south. Throughout its extensive range *T. p. centralis* is an extremely variable race, and there are scarcely greater differences between the two Nevada populations now examined than between both of these and topotypical specimens of *centralis.* These several differences have been summarized by Hall and Davis, (Hall and Davis, Univ. Calif. Publ. Zool., vol. 40, p. 398, 1935). It is of especial interest, however, to note that the specimens from near the California-Nevada boundary show great variability in the degree of inflation of the mastoid; in some individuals it is quite as inflated as in typical *centralis*, while in others

it is as little inflated as in *riparius*. In tone of color, also, some of our Colorado River series of *centralis* closely approach *riparius*.

The specimens collected were trapped in sandy soil of the bottom-land, where the associated vegetation was chiefly a coarse grass. Some workings were found in a clay bank, but not far from the level of the riverbottom.

Thomomys chrysonotus Grinnell

Specimens of this species from the following localities are now in the Museum. *Yuma County, Arizona:* 3 miles south of Ehrenberg (3); 4.3 miles north of Ehrenberg (14); 8.5 miles north of Ehrenberg (1); and 2 miles south of Parker (39). Total 57. The majority of this series was obtained through the vigorous efforts of Miss Mary M. Erickson.

This form was named (Grinnell, Univ. Calif. Publ. Zool., vol. 10, pp. 174–175, 1912) from a single male specimen taken in 1910 on the gravelly mesa near Ehrenberg. Recent description of a supposed race, *Thomomys fulvus flavidus* Goldman, from Parker indicates the need for a more complete characterization of *chrysonotus*. The Alexander expedition has added 18 specimens from the vicinity of Ehrenberg. A selected average female from that series is described below.

Size moderate, about that of topotypical *T. perpallidus perpallidus*. Coloration in winter pelage, ochraceous buff above with a clear golden tone in some individuals; facial region with dusky admixture; ear patch small, indefinite, blackish; underparts dull ochraceous buff, hair bases plumbeous, but with large irregular blotches of pure white, especially in pectoral and inguinal regions. This ventral white blotching is present in the type and in almost every specimen examined. This feature thus serves to distinguish *chrysonotus* from every other race of the Colorado Valley.

Skull heavy and massive; nasals long, truncate posteriorly, ending almost evenly with premaxillary extensions; zygomatic arches heavy, widely spreading, their sides nearly parallel, little emarginate; anterolateral angle of zygoma little produced except in old specimens; zygomatic plate with ventral margin little emarginate; hamulus of lacrimal small, closely applied to maxillary; brain-case appearing relatively short and broad; postzygomatic crest concave laterally; occiput flattened, area of attachment of suboccipital muscles sharply defined, rugose; tympanic bullae rounded, strongly inflated; mastoid bullae strongly inflated, considerably exposed posteriorly. Incisors projecting beyond nasals, curvature about as in *albatus* and *riparius*.

Measurements.—See table, p. 8.

Distribution.—Alluvial bottom-land of Colorado Valley on east side of river from south of Ehrenberg north to Parker; also edge of adjacent creosote-bush mesa.

Remarks.—Goldman (Jour. Wash. Acad. Sci., vol. 21, pp. 417–418, 1931) has described a pocket gopher from Parker as *Thomomys fulvus flavidus*. The series now available from this region (39 from near Parker, 18 from near Ehrenberg) shows complete overlapping between specimens of the two localities as far as coloration is concerned. The white ventral spotting is uniformly present. The skull characters as given by Goldman are also within the range of individual variation. The Parker specimens, however, are slightly larger, and in some specimens the premaxillaries extend decidedly farther behind the nasals. The valley is continuous, and probably the pocket gophers are of essentially continuous occurrence between the two places (about 45 miles apart).

The characters given in the above diagnosis sufficiently distinguish *chrysonotus* from adjacent races. Skull characters indicate its relationship to the *albatus-riparius-centralis* series, yet actual intergradation is not demonstrated in the material at hand.

Thomomys harquahalae, new species

Type.—Adult female, skin and skull, no. 62085, Mus. Vert. Zool.; Ranegras Plain, 10 miles west of Hope, Yuma County, Arizona; altitude approximately 950 ft.; collected by Louise Kellogg; orig. no. 2856; February 27, 1934.

Diagnosis.—A large, gray-appearing pocket gopher closely related to *Thomomys cervinus* Allen. Coloration very similar to that of the wood rat *Neotoma albigula*; upper parts between pale ochraceous buff and pinkish-buff, overlaid with blackish, this shade being heaviest near mid-dorsal line and more evident in winter than in summer pelage; facial area dusky; ear patches black, irregular; underparts whitish, plumbeous bases of hairs showing through. Skull heavy and massive; rostrum heavy; nasals long, forming a chevron-shaped suture with frontal; premaxillaries extending behind nasals; zygomata heavy, widely spreading (especially in males), sides converging slightly anteriorly, little emarginate; ventral emargination of zygomatic plate angular; hamulus of lacrimal large, projecting dorsally and posteriorly from root of zygomata; occiput flattish, rugose; tympanic bullae rounded, strongly inflated; mastoid bullae irregularly inflated (bulging, not rounded), little exposed posteriorly; interpterygoid space U-shaped in females, and wide. Incisors projecting beyond nasals, thus procumbent, although to a minor degree; heavy and broad.

Measurements.—See table, p. 8.

Distribution.—Ranegras Plain (3 adults) and valley region near (northwest of) Harquahala Mountains (bunch grass association) (1).

Remarks.—Goldman (Proc. Biol. Soc. Wash., vol. 46, pp. 74–75, 1933) has described *Thomomys fulvus subsimilis*, from the Harquahala Mountains. This, apparently, is quite a different animal, closely allied to *T. fulvus desertorum* Merriam but paler. It is smaller and has a weaker skull than *chrysonotus*. On the contrary, *T. harquahalae* is larger, with a heavier skull, than *chrysonotus*. Its subterminal color bands are paler, while the terminal bands are black and much longer. In the former, the winter pelage is the darker. From *Thomomys cervinus*, its closest relative, *T. harquahalae* differs in being smaller and paler; rostrum shorter; zygomata relatively more widely spreading, widest posteriorly; molars smaller; incisors more procumbent. The characters given in the diagnosis differentiate *harquahalae* from other adjacent races.

The type is in molting pelage and is lighter in color than the others. The specimen from the base of the mountains (5 miles south of Salome), on the contrary, is almost black mid-dorsally.

Thomomys suboles Goldman

This species is represented in the collection of the Museum of Vertebrate Zoology by 24 topotypes collected by Annie M. Alexander and Louise Kellogg near the Old Searchlight Ferry, Mohave County, Arizona, June 4 and 5, 1932. Evidently it is closely related to *T. desertorum* of the nearby Detrital Valley, but no intergradation with this species is indicated in the material at our disposal. It is similar in color to *desertorum* and somewhat larger, with much more massive and angular skull, as stated by Goldman in his full description of *suboles* (Proc. Biol. Soc. Wash., vol. 41, pp. 203–204, 1928).

Its smaller size and much brighter, richer coloration distinguish *suboles* externally from *chrysonotus*. The relatively higher, narrower brain-case, less widely spreading, anteriorly converging zygomata, smaller, markedly deflated bullae, smaller external auditory meatus, and smaller molars distinguish it cranially and dentally from that species.

This gopher differs also from *centralis*, from the opposite bank of the river, although

Measurements, in millimeters, of representative specimens of the races of Thomomys in the lower Colorado Valley

	SEX	MVZ NO.	LOCALITY	TOTAL LENGTH	TAIL	HIND FOOT	BASILAR LENGTH	LENGTH OF NASALS	EXTENSION OF PREMAXILLAE POSTERIOR TO NASALS	GREATEST ZYGOMATIC BREADTH	WIDTH ROSTRUM MEAN MIDDLE	LEAST INTERORBITAL WIDTH	MASTOID WIDTH	HEIGHT OF SKULL, BASION TO INION	MAXILLARY ALVEOLAR LENGTH	WIDTH OF INCISOR
T. p. albatus†	♀	62013	Old Fort Yuma, Calif.	215	63	32	33.4	13.8	1.2	23.4	7.7	6.5	19.4	10.25	7.9	2.0
*T. p. lucidus**	♀	39119	Las Palmas Cañon, Lower Calif.	202	64	30	30.3	11.8	1.75	20.8	7.3	6.6	15.1	9.2	8.0	2.0
T. p. phasma	♀	62077	Wellton, Ariz.	204	65	28	29.7	11.5	1.8	20.3	8.0	6.2	18.3	9.7	8.2	2.0
*T. p. depauperatus**	♀	62079	Tinajas Altas, Ariz.	188	60	28	27.9	10.3	1.2	19.8	6.7	6.8	18.0	9.5	7.2	1.6
*T. p. riparius**	♀	61985	Blythe, Calif.	228	76	31	33.9	13.4	2.0	25.0	8.0	6.9	19.8	10.35	7.5	2.2
T. p. centralis	♀	61518	Calif.-Nev. line, Clark Co., Nev.	209	62	30	32.1	13.5	1.7	24.0	7.7	6.5	20.3	10.9	8.3	2.2
T. chrysonotus†	♀	62095	Ehrenberg, Ariz.	209	72	29	31.3	13.6	1.0	23.3	7.1	6.6	19.0	10.2	8.2	2.1
*T. harquahalae**	♀	62085	10 mi. W. Hope, Ariz.	235	69	33	34.8	14.3	0.85	25.8	8.4	6.6	21.6	10.9	8.0	2.2
T. suboles†	♀	55518	Old Searchlight Ferry, Ariz.	198	61	25	29.2	12.7	0.75	21.1	7.6	6.6	17.85	10.4	8.5	1.9
*T. p. albatus**	♂	10618	Near Pilot Knob, Calif.	272	100	35	38.5	15.0	2.3	28.0	8.6	6.4	22.0	11.3	8.3	2.4
T. p. phasma†	♂	62083	Tule Tank, Ariz.	211	66	29	31.9	12.5	1.8	23.3	8.2	6.7	20.1	10.2	7.8	2.3
T. p. riparius†	♂	61981	Blythe, Calif.	262	88	35	36.8	14.4	1.6	25.7	8.7	6.6	21.5	11.5	8.1	2.4
T. p. centralis	♂	61512	Calif.-Nev. line, Clark Co., Nev.	246	84	31	36.2	15.5	1.9	26.0	8.5	6.5	22.1	11.1	9.0	2.5
T. chrysonotus†	♂	61997	Ehrenberg, Ariz.	241	84	32	34.5	15.0	0.5	26.1	8.4	6.5	20.9	11.0	8.0	2.2
T. harquahalae†	♂	62087	10 mi. W. Hope, Ariz.	230	63	34	36.3	14.4	2.3	26.7	8.7	6.5	21.3	11.0	8.2	2.4
T. suboles†	♂	55522	Old Searchlight Ferry, Ariz.	206	64	27	32.0	13.9	1.9	23.0	8.1	6.6	19.0	10.8	8.0	2.2

* Type specimen.
† Topotype.

the two forms live under similar conditions of soil, climate, and food. The former is a much smaller animal; coloration much brighter ochraceous, skull more slender, braincase higher and narrower, zygomata less widely spreading, converging anteriorly, tympanic bullae and external auditory meatus smaller.

It will be noted from the preceding systematic treatment of the forms of *Thomomys* in the Colorado River Valley that we refrain from joining in the current tendency to apply the "artenkreis" concept far and wide in handling the nomenclature of mammals. We see to what it has led in ornithology, on the part of certain authors; namely, to the trinomialization almost without limit of names of the lesser differentiated, even though sharply cut off, forms. We fear that this trend in the systematic treatment of variable genera of mammals such as *Thomomys* will lead to limitless confusion. It can act only to conceal true phylogenetic relationships and the important bionomic bearings of geographical distribution, and this without conferring compensatory benefits.

The employment of the artenkreis basis for using trinomials involves dependence upon that subjective factor vernacularly called "hunch". In other words, it means forsaking the objective criterion—that of intergradation *demonstrated to exist* on the present time level—in determining whether to use, for a given form, the trinomial rather than the binomial. A related consideration is that, despite the great activity in describing new forms of *Thomomys* (a genus which by reason of sedentary habits plus extreme ecologic restriction is subject to extraordinary geographic differentiation), there is yet apparent no satisfactory appraisement of the many cranial, dental and coat characters employed. Describers of new forms, and even revisers, it seems to us, have not discriminated correctly between the deeper seated, therefore truly important, characters (for taxonomic expression) and those that may be more fleeting—responsive more directly and immediately to varying conditions of environment. Nor are we ourselves able, at the present stage of our studies, to do any better.

For the above reasons, then, we prefer the conservative course; namely, that of restricting the use of trinomials to forms definitely known to intergrade with each other—the term intergradation being understood in the sense of either geographic or individual mergence in all taxonomic characters. We are inclined here, in practice, to consider the occurrence of "hybrids" (if recognizable as such) between "good" species as not being indicative of real intergradation. That this course involves difficulties is freely acknowledged, but it is urged as less likely to mislead than the general adoption of the optimistically subjective, artenkreis system, whereunder no two workers would be likely to agree just where lines delimiting their "species" should be drawn.

Returning to a consideration of the 9 forms of pocket gophers we now recognize from the lower Colorado Valley, it is apparent that the effectiveness of the Colorado River as a barrier to progressive spreading and intermixing in this non-aquatic genus of mammals, increases northward from its mouth. Near its mouth, in the delta region, the river apparently is no permanent barrier at all, for the well-known reason that it is prone frequently to shift its channel. By this process, in the course of relatively brief periods of years, areas of bottom-land are transferred from one side of the previously existing channel to the other side of a new channel. Mixing of pocket gopher populations probably results, reducing the chances for maintaining homogeneity on the two sides. Thus is explained the presence of the single subspecies, *Thomomys perpallidus albatus*, on the bottom-lands of both sides of the Colorado River from the vicinity of Yuma into the delta proper.

Farther up the river, progressively, despite similarity of climatic, edaphic, and floral conditions on the two sides, we find greater and greater amounts of difference obtaining between the separated populations of gophers. The climax of this tendency is reached in the portion of the Colorado drainage below Boulder Cañon, at Old Searchlight Ferry, where the extremely different forms *centralis* and *suboles* exist on opposite sides of the

river almost within a stone's-throw of one another. The channel of the river here has been fixed, from geologically very remote times.

A further factor for differentiation of a bottom-land dweller, sedentary and therefore as closely dependent ecologically as is *Thomomys*, lies in the intervening highlands of forbidding habitat through which the river passes in narrow gorges. Up-and-down-river barriers thus are constituted. Two conspicuous examples of this sort are situated between the Laguna Dam and the Palo Verde Valley, and between the latter valley and that portion of the river's course just below Boulder Cañon—the east-west barrier that roughly lies between Parker and Needles.

The down-river sequence in amount of differentiation is thus a significant illustration of the fact that *degree of isolation* is an effective factor in the speciation processes. To summarize, in this connection: the greatest difference is exhibited farthest up the river, below the Boulder Cañon (*centralis* versus *suboles*); lesser difference is exhibited in the Palo Verde Valley (*riparius* versus *chrysonotus*); and the least difference, if any, in the vicinity of Yuma and southward (*albatus*).

The limiting factors just defined, we hasten to say, are not at all likely to operate alone. What happens, gopher-wise, around the remote upper drainage basin of the Colorado River we do not know. And the long-time effects of continued convergent impingement of population movements, from differentiation centers far east or far west of the river, upon the populations immediately adjacent to the river's channel, are conjectural, although probably potent.

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REARING WILD ANIMALS IN CAPTIVITY, AND GESTATION PERIODS

By C. Emerson Brown

Very little has been written regarding the rearing of captive wild animals or the gestation periods of various animals in the wild, for it is very difficult to secure such data. This information, however, is of very great importance to those in charge of a collection of valuable animals. Especially is this so in regard to definite knowledge of gestation periods of those sorts likely to breed, in order that steps may be taken to prevent accidents. In certain species the males must be separated from the females some time before the expected birth; in other cases the females must be provided with quiet dens where they will not be disturbed by the inquisitive public and the work of the keepers; while still others must have a certain depth of water arranged for them. Generally speaking, it is always safer to separate the males from the pregnant females several months in advance of the expected birth, and so far as possible to give all such females the benefit of peace and quiet. During the period when I was director of the Philadelphia Zoological Garden, we found that in the case of all of the anthropoid apes, it is advisable, for safety's sake, to separate the sexes 2 or 3 months before the time of a birth. Each animal has its own individual temperament, and in certain cases it is quite possible to keep the pair safely together, but in my opinion separation is always advisable.

I am well aware that scattered throughout the literature there is considerable information regarding gestation periods, and that some of these differ from the figures given in the present report. No attempt has been made to gather and digest these. The figures herein offered are solely those secured by personal experience, or in some instances, periods that have occurred in other zoological parks.

The first chimpanzee born in the Philadelphia Zoo (a male) was raised on the bottle, as the mother, who was only about 8 years old at the time, did not seem to understand just how to care for her offspring. She would croon over him and show considerable affection, but would not raise him to nurse. We left him with her undisturbed for two days, hoping that the nursing instinct would develop, but it did not, and fearing that the baby would starve we removed him from the cage. First he was wrapped in a blanket and put in a warm, sunny place, then given warm milk by medicine dropper, while we tipped his head back and rubbed his throat gently to induce swallowing. After being fed with a medicine dropper for three days, the baby began to show a strong inclination to take a nipple, and from that time he nursed readily. At the age of one week he was taking from 10 to 12 ounces of diluted milk (half water) daily. While for more than 5 months he appeared to be gaining in strength, he showed no signs of creeping or walking, only turning on his side occasionally. He did develop many intelligent ways, however. In a paper by Miss Bessie White, who helped care for him, there is the following statement: "This fascinating picture of babyhood, differing from the human only anatomically, was progressing serenely until the end of the sixth month, when clouds appeared on the horizon. A restless night, fever, two weeks of illness and suspense, then on April 12, the soul of the only captive-born, bottle-fed chimpanzee on record swung back to the celestial jungles, leaving the little body to pathology . . . ."

On April 26, 1930, another tiny chimpanzee was ushered into the world by Marianne, the same mother, this time to be cuddled and nursed from the start. Under her mother's care, Aprilla (a female) developed much faster than did her brother. She is now over 5 years old and in fine condition. She was separated from her mother when she was one year old.

So little has been written regarding gestation periods of mammals that I do not hesitate to submit such material as I have; therefore, I offer the following from my own observation and from records kept by Robert D. Carson, a former Director of the Philadelphia Zoological Garden. All records from our Garden, where elapsed time was actually known, are so quoted.

The size of the animal apparently has very little if any bearing on the period of gestation, although in the case of the elephant, the largest living land mammal, the gestation period is the longest. In the hippopotamus, however, which may weigh 2 or 3 tons, the period is only about 8 months, while the pigmy hippopotamus, weighing only 400 pounds, carries its young

about 9 months. For the kangaroo the period is short, being only about 38 to 40 days. At birth the young of these animals are 1 to 3 inches long. Unaided they find their way to the pouch, where they attach themselves to a nipple, through which the milk of the mother is injected. They hang in the pouch until fully developed.

GESTATION PERIODS

(Starred records are of animals born in the Philadelphia Zoo)

Primates

* Chimpanzee (*Pan satyrus*).—About 9 months for the 3 born in Philadelphia.
* Orang-utan (*Pongo pygmaeus*).—8 to 9 months; 2 born in Philadelphia and only 5 in captivity elsewhere.
* Pig-tailed monkey (*Macaca nemestrina*).—About 7 months.
* Rhesus monkey (*Macaca mulatta*).—Philadelphia data indicate a period not exceeding 6 months.
* Crab-eating monkey (*Macaca irus*).—About 7 months.

Carnivora

* Lion (*Felis leo*).—16 weeks, less 1 day.
* Tiger (*Felis tigris*).—15 weeks and 4 days.
Leopard (*Felis pardus*).—3 months.
Jaguar (*Felis onca*).—3 and one-third months.
Puma (*Felis concolor*).—3 months.
* Coyote (*Canis latrans*).—64 days.
* American gray wolf (*Canis lycaon*).—9 weeks.
* Common skunk (*Mephitis mephitis*).—63 days.
European otter (*Lutra lutra*).—87 days from first and 61 days from last coition.
* Racoon (*Procyon lotor*).—69 days from first coition.
* Coati (*Nasua nasua*).—77 days.
* Grizzly bear (*Ursus horribilis*).—236 days.
* Black bear (*Euarctos americanus*).—About 7 months and 1 week.

Pinnipedia

* California sea-lion (*Zalophus californianus*).—From 11.5 to 12 months.

Rodentia

Muskrat (*Ondatra zibethica*).—21 days (T. H. Patton, St. Louis).
* Golden-rumped agouti (*Dasyprocta aguti*).—104 days.

Proboscidea

Indian elephant (*Elephas maximus*).—20 months and 20 days, in Frankford, Philadelphia.

Ungulata

Malayan tapir (*Tapirus indicus*).—13 months.
* Brazilian tapir (*Tapirus terrestris*).—13 months in Washington and Philadelphia zoos.
* Burchell zebra (*Equus burchelli*).—11 months and 6 days; and 11 months and 20 days.
* American bison (*Bison bison*).—9 months.
* Indian buffalo (*Bubalus bubalus*).—About 10 months.
* Yak (*Poephagus grunniens*).—From 8.5 to 9 months.

* Livingston eland (*Taurotragus oryx livingstonii*).—Exactly 9 months.
Gnu (*Connochaetes* sp.).—From 8 to 8.5 months.
* Indian antelope (*Antilope cervicapra*)—6 months.
* Nilgai (*Boselaphus tragocamelus*).—Not more than 8 months and 7 days.
* Himalayan thar (*Hemitragus jemlahicus*).—About 6 months.
* Aoudad (*Ammotragus lervia*).—From 22 to 23 weeks.
Uriel (*Ovis vignei*).—About 6 months.
Rocky Mountain sheep (*Ovis canadensis*).—About 6 months.
* Red deer (*Cervus elaphus*).—About 8 months.
* Wapiti (*Cervus canadensis*).—About 8.5 months.
* White-tailed deer (*Odocoileus virginianus*).—About 7 months.
* Fallow deer (*Dama dama*).—8 months.
* Axis deer (*Axis axis*).—7 months and 8 days.
* Japanese sika deer (*Sika nippon*).—8 months.
* Hog deer (*Hyelaphus porcinus*).—8 months.
* Llama (*Lama glama*).—11 months.
Huanaco (*Lama huanacus*).—11 months.
Arabian camel (*Camelus dromedarius*).—From 12 to 12.5 months.
* Hippopotamus (*Hippopotamus amphibius*).—From 235 to 243 days.
* Pigmy hippopotamus (*Choeropsis liberiensis*).—About 9 months.
* Northern wart hog (*Phacochoerus africanus*).—171 and 175 days.

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STOMACH CONTENTS OF FUR SEALS TAKEN OFF THE COAST OF WASHINGTON

By Leonard P. Schultz and A. Morris Rafn

The table printed below shows the stomach contents of 41 fur seals taken within 30 miles of La Push, Washington, during March, April, and May, 1930, by Indian hunters, who are permitted to hunt these animals by primitive methods. These stomachs were given to us for examination by the State Fisheries Department, Seattle. From this table it may be observed that the stomachs ranged in content from complete emptiness to two quarts. The preservation was made a number of hours after killing; thus the contents were much digested and often difficult to analyze. The number of beaks and eyes of squids remaining in the stomachs indicated the number of squids recently eaten, because each squid possesses two eyes and two beaks. Since the eyes and beaks are mostly indigestible, some pass out before the others; this accounts for the odd numbers. The number of herring present was determined by the number of vertebral columns. The average length of the herring eaten seemed to be about 8 inches.

In one stomach 8 small shrimps were found, and in another only a 5-inch lamprey (*Entosphenus tridentatus*). Each stomach contained numerous parasitic round worms, the maximum number being 122. No bones nor flesh of salmon were found. Partly digested, pink-colored squid meat might have

Stomach contents of fur seals taken off the Coast of Washington

NO. OF THE FUR SEALS	NO. OF SQUID EYES	NO. OF SQUID BEAKS	NO. OF SHRIMP REMAINS	NO. OF HERRING; VERTEBRAE, ETC.	LAMPREY	NO. OF ROUND WORMS	NO. OF PINTS OF STOMACH CONTENT
1	12	18	..	..	..	54	¼
2	25	40	..	1	..	20	1¼
3	..	..	..	17	..	66	3
4	..	..	..	..	..	..	..
5	1	4	8	7	..	39	½
6	..	..	..	..	..	10	1½
7	22	32	..	..	..	36	1
8	..	..	..	1	..	1	1/10
9	5	9	..	..	..	35	½
10	..	2	..	10	..	57	1
11	8	9	..	9	..	122	3
12	6	9	..	18	..	74	4
13	5	5	..	..	..	42	½
14	7	12	..	..	..	66	½
15	10	14	..	..	..	8	¼
16	26	30	..	..	..	10	3
17	2	..	..	..	..	103	½
18	..	..	..	..	1	..	..
19	3	9	..	1	..	38	½
20	..	..	..	..	..	..	..
21	..	2	..	..	..	10	..
22	..	..	..	..	..	..	..
23	..	..	..	..	..	1	..
24	..	..	..	..	..	43	..
25	..	2	..	3	..	49	½
26	..	2	..	..	..	52	½
27	6	6	..	1	..	41	½
28	..	..	..	..	..	..	..
29	..	..	..	1	..	14	¼
30	2	2	..	4	..	5	½
31	..	..	..	..	..	32	..
32	..	..	..	..	..	3	..
33	..	..	..	..	..	..	..
34	..	..	..	..	..	..	..
35	..	..	..	4	..	64	¼
36	..	..	..	..	..	..	..
37	9	10	..	13	..	72	4
38	..	..	..	..	..	..	..
39	..	..	..	..	..	1	..
40	..	..	..	..	..	1	..
41	2	2	..	3	..	43	½

been mistaken for that of salmon if the structure of the flesh had not been carefully studied.

Thirteen of the stomachs were completely empty except for a few parasitic worms. Specimen 23 contained a large clot of blood.

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THE ATTRITION AND EXTRUSIVE GROWTH OF THE FOUR MAJOR INCISOR TEETH OF DOMESTIC RABBITS

By Albert R. Shadle

Although it has been known since 1768 that the incisor teeth of rabbits grow continuously, nothing has been done to determine the rate of extrusive growth and the amount of tooth erupted and worn away during a long period of time.

From studies of cases of malocclusion, Fougeroux (1768) recognized that the incisors of certain rabbits continued to grow. In further experiments, Lavagna (1812) announced that when parts of incisors of rabbits were cut away, they were replaced, and that extracted incisors would be replaced provided the pulp did not suffer serious damage. Oudet (1823) demonstrated, by marking the teeth, that the incisors of all hares and rabbits grow continuously, but he made no particular effort to determine the rates of extrusive growth and of attrition. MacGillavry (1875), while studying the incisors of the rat, made one set of marks on the lower incisors of a "young adult rabbit," and reported an attrition of 3.5 mm. during the week of observation.

OBJECT OF THE STUDY

The object of this study was to determine over a long period of time, the amounts and the rates of attrition and of extrusive growth of the four major incisor teeth in domestic rabbits. The two posterior upper incisors, or "peg teeth", were not studied.

Previous workers in this field have ordinarily made no distinction between *rate of growth* and *rate of attrition*, and *amount of growth* and *amount of attrition*. The expressions have been used synonymously and interchangeably, the amount of growth for a given period having been considered the same as the amount of attrition, or the amount of tooth substance erupted and worn away. After a certain period in the life of the animal the measurements of growth and those of attrition may be practically the same; before that time the two measurements may show a considerable difference. The measurements of attrition and those of extrusive growth are confined to the erupted, or exposed portion of the tooth, and the complete growth measurements should include also that portion of the tooth embedded in the jaws. In a very young animal, the length of the embedded portion increases, thus affecting the measurements of the total growth of the tooth, but not the amount of extrusive growth. This, therefore, would not change the measurements in the amount of attrition and extrusive growth.

MATERIAL

The group of animals studied consisted of 38 domestic rabbits, including purebred chinchillas and mongrels of angoras, lopeareds, Belgians, and probably other varieties. For aid in the collection of the data, grateful acknowledgment is made to Kenneth M. Eckert and Laverne A. Wagner. It is a pleasure to acknowledge with gratitude the friendly interest and many helpful suggestions and criticisms of Dr. Hugh D. Reed of the Department of Zoology of Cornell University.

The Leporidae, the family of lagomorphs to which the hares and rabbits belong, exhibit the following dental formula:

$$\frac{I\,2\quad C\,0\quad P\,3\quad M\,3}{I\,1\quad C\,0\quad P\,2\quad M\,3}$$

The lower incisors and the two larger upper incisors are sharp, chisel-shaped, and well adapted to the details of gnawing. They grow from persistent pulps, which continue to form new tooth-structure at the base of the tooth, thereby lengthening it, or compensating for the continual wear by attrition. The two smaller upper incisors, or "peg teeth," are round, slightly bent, and rodlike, one placed directly behind each of the large upper incisors. The tips of the "peg teeth" penetrate the surface of the roof of the mouth where the lower incisors close against them. They serve mainly in protecting the tissues of the mouth from abrasion and laceration by the cutting edges of the lower incisors. In the absence, of functional upper major incisors, the "peg teeth" sometimes serve, to some extent, for cutting food and sharpening the lower incisors.

The actual period during which data on the 38 domestic rabbits were taken, varied in point of time from 24 weeks to 104 weeks per animal. The total period of observation as of one animal amounted to 2324 weeks, or 44 years and 8 months of rabbit-life.

APPARATUS AND METHOD

An electric dental engine, equipped with a rheostat and a dentist's hand piece, furnished motive power for the small wheels used in marking the teeth. There was available a wide range in speed and small dental wheels of carborundum were kept sharpened to a knife-edge for cutting a narrow, V-shaped, transverse mark across the convex (labial) surface of the tooth, several millimeters proximal to the cutting edge. By placing the bent leg of an hermaphrodite caliper against the cutting edge of the tooth and the point of the straight leg in the center of the V-mark, the distance from the apex of the tooth to the mark could be measured. This process was repeated with each of the 4 major incisor teeth, and at the end of a week each tooth was again examined and measured. The difference in these two measurements on each incisor represented the amount of tooth lost by attrition during that period of time. The frequency with which new marks were made varied according to the length of the extra-gingival portion of the tooth, together with the rate at which the teeth were being worn away.

The length of the exposed or extra-gingival portion of the major incisors varies not only among the species and breeds of domestic rabbits but individually and with age, and may even vary bilaterally. Usually the larger breeds, and larger and older individuals of a breed or species, have the greater extent of exposed tooth. The increase in length of the upper incisors varied from 4 mm. in a rabbit 47 days old to 9.3 mm. in one aged 21 months. That of the lower incisors varied from 3.5 mm. to 8.4 mm. in the same animals.

Throughout the discussion, the amounts of attrition and extrusive growth and the weekly rates are written in millimeters, after the fashion of a dental formula, thus:

$$\frac{\text{Upper Right Incisor}\,|\,\text{Upper Left Incisor}}{\text{Lower Right Incisor}\,|\,\text{Lower Left Incisor}},\ \text{i. e.,}\ \frac{2.4\,|\,2.5}{2.6\,|\,2.7}\ \text{mm.}$$

This formula means that the amount of attrition and the extrusive growth for the upper right incisor was 2.4 mm., for the upper left, 2.5 mm., for the lower right incisor it was 2.6 mm., and for the lower left, 2.7 mm.

The food of these rabbits consisted of a liberal supply of green food throughout the year, supplemented by clover and timothy hay or alfalfa. To this was added a mixed grain ration, consisting of dairy feed, ground whole wheat, ground whole corn, rolled oats, and alfalfa meal. Cod-liver oil was added to this grain mixture 2 or 3 times a week.

TOTAL ATTRITION AND EXTRUSIVE GROWTH OF 38 DOMESTIC RABBITS

This group of 38 rabbits consisted of 8 males and 18 females of uncertain pedigree, together with 5 males and 7 females of purebred chinchilla strain.

The sum of the attrition and extrusive growth of each of the four major incisors was as follows:

$$\frac{4728.5|4655.8}{5553.2|5445.8} \text{ mm.}$$

The right upper incisors exceeded the left upper incisors by 72.7 mm., while the right lower incisors exceeded the left by 107.4 mm. The combined attrition of the uppers was 9384.3 mm., and of the lowers, 10999.0 mm., an excess in the lowers of 1614.7 mm. The combined attrition of the uppers and lowers amounted to 20383.3 mm., or 20.3833 meters.

The result obtained by dividing the total attrition and extrusive growth of each incisor by 2324 (the sum total of the weeks of attrition observed) gives the average amount in millimeters of the attrition and extrusive growth per individual, per week. Computed thus, the average weekly attrition rates of the major incisors were:

$$\frac{2.034|2.003}{2.476|2.343} \text{ mm.}$$

In both upper and lower major incisors, the right tooth had the higher rate, and the rates of the lowers exceeded those of the corresponding uppers. The average weekly rate of attrition of the uppers was 2.018 mm., and of the lowers, 2.410 mm.

In order to determine whether or not there was any difference in the rates of attrition between the sexes, the data for males and females were assembled separately; furthermore, the data of the mongrels later were separated from those of the purebred animals. The sum total of attrition time of the 13 male rabbits amounted to 656 weeks, or 12 years, 7 months, and 2 weeks. The males showed average rates of attrition and extrusive growth per individual as follows:

a group of 8 mongrels $\frac{2.03|1.95}{2.27|2.21}$ mm.;

13 mongrels and chinchillas $\frac{1.85|1.83}{2.23|2.22}$ mm.;

5 chinchillas $\frac{1.50|1.58}{2.13|2.24}$ mm.

A similar grouping of females gave the following results:

18 mongrels $\frac{2.17|2.13}{2.53|2.44}$ mm.;

25 mongrels and chinchillas $\frac{2.10|2.07}{2.40|2.30}$ mm.;

7 chinchillas $\frac{1.93|1.93}{2.26|2.27}$ mm.

The average individual weekly rates were higher in females than in males, both collectively and in the corresponding individual groups. The mongrels, both male and female groups, and the combined group, had a higher attrition rate than the corresponding chinchilla group. The lower incisors had a higher rate of extrusive growth and attrition than the upper incisors, and usually the right tooth surpassed the left in rate.

The attrition and extrusive growth rates of the individual incisors exhibited variations weekly, over longer periods, and during periods of different physiological conditions.

The highest rates for individual teeth, in these observations, were $\frac{4.7}{6.6}\left|\frac{4.5}{6.2}\right.$ mm., and the lowest rates were $\frac{0.0}{0.3}\left|\frac{0.3}{0.2}\right.$ mm. These figures represent the highest and lowest rates obtained for each of the major teeth during the observations, and represent the records of different rabbits at different times.

EXTRUSIVE GROWTH AND ATTRITION TRENDS DURING PREGNANCY

During 66 cases of pregnancy, 73 per cent of the individual major incisor teeth increased in the rate of extrusive growth and attrition, 24.5 per cent decreased, while in 2.5 per cent there was no change. The breeding and the post-parturition periods evidently affect to some extent the extrusive growth and attrition. The results, however, are not as conclusive as those during pregnancy. Further data are being collected in an attempt to clarify these points.

CHANGE IN ATTRITION RATES WITH INCREASE IN AGE

To determine the effect of increase in age upon the rate of extrusive growth and attrition, the observations on each animal were divided into periods of 6 months each, and the average attrition rate of each major incisor was obtained for each of these six-month periods. The results were tabulated and analyzed. They indicate that the mongrels reached their highest average rate of extrusive growth and attrition at 2.5 to 3 years of age, while the chinchillas reached their maximum rate at an earlier age. Following this maximum rate period there is usually a definite decline in rate with further increase in age.

EXTRUSIVE GROWTH AND METHOD OF ATTRITION

The physiological activity of the organism, as expressed by the extrusive growth of the incisors, often results in the production of amounts of tooth-substance beyond the actual needs of the animal; it may even result in becoming a metabolic burden.

The sharp edges of the incisors, according to Mummery (1919), are due to the fact that the dentine and the cement wear away much more rapidly than the hard enamel, which is thus left projecting as a sharp cutting edge. While it is true that there is an unequal wear of these 3 kinds of substances, my own observations suggest that this difference in hardness is only one of the factors present. The shape of the distal end of the incisors, when viewed in profile, is strong evidence of the planing or routing action of each pair of incisors on the opposite pair. Additional evidence is seen in slight grooves and ridges in the abraded dentine surface, corresponding to slight imperfections in the enamel edge of the opposite tooth.

A beaver, while under an anesthetic, demonstrated this routing action of the upper incisors on the posterior side of the lowers. The mandibles were lowered sufficiently for the tip of the lower incisors to clear the cutting edges of the uppers. The jaws then closed so that the cutting edge of the upper incisors rested upon the anterior side of the beveled surface of the lower incisors. While the teeth were held thus closely adpressed,

the lower jaws were shoved forward and the upper incisors routed or planed away a layer of material from this beveled surface of the lowers. The planings from the teeth resembled the scrapings obtained by running a steel tool over ivory. This action was repeated several times and was clearly observed by 4 persons. It is my opinion that this routing action of one pair of teeth upon the other is the factor of maximum importance both in shaping the distal end of the incisors and in causing their attrition. The degree to which this routing action exceeds the effects of ordinary wear must be determined by experimentation.

In the rabbit, the extrusive growth is far beyond the amount which is necessary to replace the material worn away in gnawing food and other substances. This excess growth must be worn away by the abrasion of the lingual side of the upper incisors against the lowers. Then, by reversing the cutting action, the lingual sides of the lowers are cut back by the uppers. This process maintains the chisel shape of both pairs of teeth. The rubbing together, from side to side, of the upper and lower incisors and of the upper and lower cheek teeth, is a common method of attrition. This grinding action during periods of rest led some early zoologists to consider that rabbits chew the cud.

The attrition which keeps the incisors reduced to their usual length is necessary to maintain them in a functional state (Owen 1840–45, Jones 1847–49). Any factor which for any length of time inhibits this normal grinding action, will produce malocclusion, and the degree of development of malocclusion determines whether the condition is merely a handicap in feeding, a distinct disadvantage, a marked disability, or even the cause of death from starvation.

The production of excess tooth material and the necessity for its removal by the laborious method of grinding, are wastes of energy and, therefore, physiological burdens on the organism.

EFFECT OF POOR PHYSICAL CONDITION UPON EXTRUSIVE GROWTH OF INCISORS

A rabbit that is in poor physical condition or even one in an extreme pathological state, may continue to produce considerable quantities of tooth substance. This production may continue even when the body is so emaciated from food deficiency that breeding and other important functions are impaired. Orban (1927) found that in rats fed on the poorest diets, the growth of the incisors did not cease. He also observed that the growth of the body does not depend on the same factor as the growth of these teeth. It was interesting, however, to note the degree of similarity in the trends of weight and attrition as indicated by graphs. Severe illness often did not show any marked effect on the extrusive growth and the attrition of the incisors until 2 or 3 weeks before death. Dalldorf and Zall (1930) stated that in feeding experiments with guinea pigs, the deprivation of vitamin C caused the teeth to cease growing.

MEASUREMENTS OF ABNORMAL RABBITS

The measurements of extrusive growth of the lower incisors made by Noé (1902), were upon a rabbit with an advanced case of malocclusion. In the 13 days intervening between the time at which the lower incisors broke off at the point of emergence from the jaw, and the death of the animal, the two lower incisors each grew at the rate of 4.3 mm. per week. From unpublished data on malocclusion, I am convinced that the rate mentioned by Noé is higher than that in normal animals. Studies of malocclusion in domestic rabbits, now in progress, show that the breakage of the incisors near the gum is usually followed first by a sharp increase in the growth rate, and then by a gradual reduction in rate of growth throughout subsequent weeks. In one rabbit, rates of 5.8, 5.9, 6.3, and 6.5 mm. have been observed immediately after breakage of the lower incisors,

while the average weekly growth-rate of each of the lower incisors of this animal, over a period of 22 months, was 2.67 mm. per week.

EXTRUSIVE GROWTH OF INCISORS IN RODENTS

Guinea pigs from 4 to 10 weeks old, observed during periods of 20 to 90 days, were used by Dalldorf and Zall (1930) in determining the tooth growth during attacks of scurvy induced experimentally. They reported a maximal daily rate of growth of .850 mm., or a weekly growth rate of 5.9 mm. in animals fed on an abundance of green vegetables, and a minimal daily rate of .306 mm., or a weekly rate of 2.1 mm., in the control animals.

One group of 6, and a second group of 4 adult albino rats, were studied by Addison and Appleton (1915). Measurements were taken during successive weeks. The longest period of measurements was 6 weeks, and the growth averages were 2.2 mm. per week for the upper and 2.8 mm. for the lower incisors. These rates are higher than any of the averages for groups of rabbits. Several of the mongrel rabbits showed, over a short period, rates as high as, or higher than, those for the rats. Addison and Appleton called attention to the fact that there may be variations of growth under various conditions, and that their figures represent a rate for one particular set of conditions. Marshall (1921) reported: "The extrusive growth of superior incisor teeth (of albino rats) amounts to about 1.9 mm. per week and of the inferior incisors to about 2.3 mm."

GROOVES IN LOWER INCISORS

According to Wortman (1886), and Cornevin and Lesbre (1894), the lower incisors of the rabbit are not grooved. Rabbit no. 14, however, showed very distinct grooves in each of the lower incisors. Cornevin and Lesbre also described the first molar (apparently meaning the first lower premolar) as limiting the penetration caudal to the base of the lower incisor. X-ray examinations of adults of my group of rabbits do not corroborate this observation. The base of the lower incisor may frequently lie medial to the first premolar, and may extend along the lingual side of this tooth to the level of the second premolar.

CONCLUSIONS

Variations notwithstanding, the following generalizations seem warranted:

1. For the group of rabbits studied, the average weekly rates of the extrusive growth and attrition of the individual incisors are $\frac{2.03 \mid 2.00}{2.47 \mid 2.34}$ mm., and the annual amounts are $\frac{106 \mid 104}{128 \mid 122}$ mm. per rabbit, (approximately 4 inches in the uppers and 5 inches in the lowers). A sum total of 460 mm., or 18 inches, of major incisor tooth is annually extruded and worn away.

2. The amount of tooth substance produced by each major incisor of the rabbit exceeds the replacement needs due to eating and to the usual gnawing processes of the animal. This production is to be regarded, therefore, as a metabolic activity that exceeds the needs of the animal.

3. Excess of tooth-structure must be removed continually in order that the normal functional relations of the major incisors may be maintained.

4. There is considerable variation in the amounts and rates of extrusive growth and attrition in different species and in different breeds of rabbits, in different individuals, in the individual incisors, and in the different functional states (illness, reproduction) of the individuals.

5. Female rabbits have a higher rate of extrusive growth and attrition than have males.

6. During pregnancy, females showed increased attrition and extrusive growth in 73 per cent of the major incisors.

7. Mongrel rabbits show higher attrition and extrusive rates than chinchillas.

8. Of the major incisors, the lowers, with a few exceptions, exceed the uppers both in amount and weekly rates of attrition and extrusive growth.

9. The right incisor usually exceeds the left in total amount and weekly rates of extrusive growth and attrition.

10. The highest weekly extrusive growth and attrition rate here recorded for an individual tooth is 6.6 mm., the lowest, zero.

11. The average amount of extrusive growth and the average rate of attrition increase up to a certain age in the mature animal; later they decrease. This age varies according to the race or breed of rabbit. The amount also varies individually (probably according to physiological state).

12. Lower incisors of rabbits sometimes exhibit grooves on the labial surface, similar in position, proportions, and extent, to those characteristic of the upper incisors. The author is inclined to believe the explanation will be found during a study of the morphology of the teeth, now in progress.

13. The length of the extra-gingival portion of the major incisors is variable, but that of the upper teeth is usually greater than that of the lower teeth. The reverse of this condition is present in most rodents.

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NOTES ON THE YOUNG OF THE ALLEGHENY WOOD RAT

By Earl L. Poole

During the early spring of 1934, I set out a series of live traps along a rocky ledge on the south side of the Blue Ridge, near Shartlesville, Pennsylvania, in the hope of obtaining information on the breeding habits of the Allegheny wood rat (*Neotoma pennsylvanica*). Although several specimens had been taken in this locality during previous years and signs of their activity were in evidence, it was not until after several weeks of intermittent trapping that the first specimen, a large male, was taken, April 15. Four days later a female was captured at the same spot, and the two were placed in a large cage fitted with a double nest-box which could be opened from the outside, so that their activities could readily be observed.

From the first these animals were quite tame, and submitted to handling without making any effort to bite, although the male, on the day that it was caught, quickly killed a red-backed mouse that was placed in the same bag. I observed that the pair appeared to be congenial from the start, so it seemed likely that they had been acquainted, or perhaps mated, before their captivity. At this time they both used the same nest-box, although another box was available, making a snug nest of the tow and excelsior that had been provided.

When disturbed during the daytime they were very lethargic and fearless of human beings, only showing resentment of familiarity by pushing one's hand away with their forefeet. This, I learned, was the common mode of defense, and the teeth were used but seldom, although, as with the red-backed mouse and in an instance to which I shall refer later, they could be employed with great suddenness and telling effect.

During the day these captives remained coiled in a globular ball, with head against the belly and the forepaws acting as a sort of eye-shade, while the tail was curled horizontally around the feet.

At night, however, they were bright and active, being much quicker in their motions than the Norway rat. Their long whiskers were kept constantly in vibration, indicating that these are possessed of a very delicate tactile sense.

During the 10 weeks that I kept these rats in captivity they were never known to drink water, although it was offered them every evening. Their only apparent use for the water dish was as a place for depositing empty nut shells and other bits of refuse. Rhoads (Mammals of Pennsylvania and New Jersey, p. 90) mentions that his tame *Neotoma* lapped water like a dog, but after many hours of observation I failed to see these rats do more than sniff at it. Perhaps they found enough water in the lettuce and other succulent greens with which they were provided.

At different times many kinds of food were offered them, and I found that they were nearly omnivorous, fond of variety and even deserting their favorite

ADULT MALE NEOTOMA IMMEDIATELY AFTER CAPTURE

ABOVE: NEOTOMA PENNSYLVANICA AT AGE OF 5 DAYS
BELOW: A YOUNG NEOTOMA FOLLOWING ITS MOTHER UP THE ROCKS

apples and acorns for some new article of diet. Lettuce, the tender shoots of crabapple, shad-bush, hemlock, black birch, carrots, potatoes, nuts, grains, and fruits of any sort were devoured freely; meat was eaten only occasionally. When given cherries they ate both the pulp and the kernel, extracting the latter through a small opening gnawed in the side of the shell. Apple seeds constituted a great delicacy. In eating they used the forepaws like hands, turning the food with great dexterity. Carrying was done entirely by the mouth. All excess food was carried into the nest box and stored in the farthest corner.

They were very clean in their habits, always voiding their feces at one spot in the far corner of the cage, as far from the nest as possible. I have often noticed the result of this habit in their natural haunts, where sometimes they leave dung-heaps of considerable size.

Quite tame from the first, my rats soon learned to eat from my hand, allowed themselves to be scratched, and seemed perfectly contented. They made no effort to gnaw their cage. The common signal of disapproval or annoyance was to stamp with the hind feet, much as do rabbits and kangaroo rats. They are capable of producing a loud thump in this manner. They seldom squealed, and then only when quarreling over a bit of food.

On June 1, the female gave birth to 3 young. They were tiny, pink, naked creatures that clung almost constantly to the maternal teats. When disturbed the female dragged them out of one nest and into the other, subjecting them in the process to many hard knocks.

At about this time I noticed that the female commenced to chew at the wooden frame of the cage, and thinking that this signified a deficiency of some element in the diet, I gave her a fresh beef bone on which to gnaw. This she did; but milk offered her at the same time was not touched.

From this time she became very aggressive toward the male, and the latter was forced to take up bachelor quarters in the other nest-box, or to sleep outside. Whenever the two met she threatened him, rearing on her hind legs and thrusting him away with her forefeet, a procedure to which he meekly submitted or made merely a weak resistance.

Abstracts from my observation of the subsequent history of this family follow:

June 6.—One of the young died. It weighed 17 grams, and was covered with a coat of fine, silky, gray hair. The eyes were closed.

June 11.—The old rats must have fought last night, as this morning the male was badly chewed on the flanks. I separated them, removing the male to another cage, in which he remained, apparently dejected and broken in spirit, until liberated some days later. The young are now covered with a thick coat of light gray hair, and still cling to the mother, who drags them about with her whenever she is disturbed or wishes food while they are nursing. While their eyes are not opened, the lids are marked by a prominent black area.

June 13.—The young are now of a beautiful, pale, silvery gray, with white feet and a

prominent black spot about the eyes. The mother has become very confiding, and without displaying any fear, allows me to part the nest in order to get a better view of the young. She allows me to scratch her back, and takes each piece of food, coming back anxiously and begging for more again and again, although it is simply added to the cache that she has stored in the nest-box.

June 15.—The eyes of the young seem sensitive to light for the first time.

June 17.—The young still cling to the mother most of the time and allow themselves to be dragged about in that manner. The mother is continually hungry, and quite playful at times. At times she jumps up and down on all fours, making a loud thumping sound. Another manifestation of what seems to be the play instinct is her fondness for running into the nest with bits of food and popping out again to look for another piece. I had accidentally scattered some grain along one of the rails of the cage. Although there was a dish full of it in the cage, she carried that on the rail into the box, bit by bit, with every evidence of pleasure at having something to busy herself about. The male still seems thoroughly cowed and dejected, seldom moving from his nest and eating very little.

June 19.—The young ones can now crawl around a little. This evening their eyes are beginning to open.

June 20.—The eyes are now half-open, and hair, of the same frosty gray color as that on the back, is extending over the basal part of the tail. They cling to the mother and continue to be carried by her, although they can now crawl about the nest.

June 21.—Eyes fully open.

June 22.—This evening one of the little ones, its eyes fully open, came out of the nest-box and scrambled around the back of the cage. It seems fully capable of taking care of itself. The other is perhaps a little less advanced. For the first time I noticed that silky hair now covers the pink skin of the tail.

June 24.—The remaining young one seems well able to care for itself, chewing at various kinds of food.

The following day, as I was preparing to leave on an extended trip, I liberated the entire family at the spot where the adults had been captured. It was on this occasion that by accident the old female was roughly handled. She then inflicted a rather severe bite on the hand of my assistant.

The adults seemed from the first to realize where they were, and the mother hesitated only long enough to coax the young ones to her before they all took shelter among the rocks of their Blue Mountain home.

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A HITHERTO UNDESCRIBED COPROLITE FROM THE WHITE RIVER BADLANDS OF SOUTH DAKOTA

By J. Willis Stovall and W. S. Strain

In the summer of 1933, the Fourth Vertebrate Paleontology Expedition of the University of Oklahoma collected in the White River badlands of South Dakota. While working in that vicinity there were secured approximately 50 objects which appeared to be coprolites, or fossil droppings of extinct animals. In the study of this material the authors are indebted to a number of persons for aid rendered. In particular they wish to express their gratitude to Dr. C. A. Merritt for analyses of the mineral matter in the specimens; to Dr. George J. Goodman and Mr. O'Reilly Sandoz for interpretation of the microscopic slides and in identification of the plant material; and to Mr. F. W. Bates for assistance in the preparation of thin sections of woody material.

A preliminary field examination of the specimens revealed that the general shape closely resembled that of the droppings of modern mammals, particularly the Bovidae. It was disclosed also that they were composed of broken fragments of petrified woody material cemented together with a substance having the general appearance of calcite. Sand and a few quartz pebbles clung to one side of some of the coprolites. Three general shapes were noted, one discoidal, another crescentic and a third elliptical. All three of these types were characterized by surfaces that were more or less convex.

The specimens were in place in the "Titanotherium Sandstones," which are in the Chadron division of the Oligocene. These sandstones are not of uniform texture and are conglomeratic in some sections. It was in a lens of this sort that the coprolites were found. Each rested in a depression that was an exact cast of the side upon which it was lying. They were scattered over an area nearing 50 square feet in extent. There existed no definite relation between them other than that they were all at the same level on a small terrace with dimensions scarcely twice those of the space occupied by the coprolites. They were all seemingly weathered out to about the same degree.

When these fossils were thoroughly studied in the laboratory, the observations made in the field were reaffirmed and a number of other facts were learned. The convexity of the sides varied somewhat, which was probably attributable to the combined effects of the curling of the sides before fossilization, and of weathering both before and after fossilization. The shapes were even more striking when a close study of recent droppings was made. A careful comparison of both disclosed the fact that almost exact duplicates of each type could be found in recent bovid excreta. Not only were the shapes similar, but in a number of cases the sizes also could be duplicated. Weathering, of course, may have reduced the size of the coprolites to a greater or lesser degree.

An examination of the surfaces of the specimens showed clearly that at least two types of plants could be identified. One type was a shrub or tree, the twigs of which occasionally showed branching, and much more infrequently what appeared to be budding. Seeds appeared to be absent, possibly because of the season of the year when ingestion occurred. The second type of plant was a large weed or reed, which contained a relatively large pith. Fragments of this type were not as numerous as the heavier woody variety and appeared not to occur in some of the specimens. The plant fragments bore no very definite relation to one another and could be described as being in a heterogeneous mass. Very few, if any, of those visible at the surface were over 1.5 cm. in length, while the majority were measurable in fractions of a millimeter, as might be expected.

When slides of the twigs were examined microscopically, true cellular structure clearly could be seen. The structure of the plants was found to be preserved to such a remarkable degree that groups of cells and even medullary rays easily were recognized. There were visible various other details, particularly the conductive tissue of the plants, whose cells were in their original positions with regard to the surrounding tissue. From a study of the microscopic slides and of polished surfaces of several coprolites, there was disclosed evidence of partial digestion. The ends of the fragments were found, almost without exception, to be more or less rounded or smooth as would be expected if they had been attacked by digestive juices. The fact that the bark and cambium layer were unevenly removed from some of the stems constitutes further evidence of partial digestion.

A chemical analysis of the coprolites showed that the cementing material consisted of about 90 per cent calcite and the remainder chalcedony quartz. The plant fibers were found to have been replaced by chalcedony and clear glassy quartz, as well as calcite, the latter constituting only about 25 per cent of the total.

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MAMMALS OF NORTHWESTERN ARKANSAS

By J. D. Black

The five counties included in this report, together with Carroll County, which differs slightly in having a mixed evergreen stand over most of its area, comprise the northwest corner of the state of Arkansas, and include elevations of from 400 feet at Ozark to 2250 feet or more near Winslow. From this divide near Winslow the Ozarks fall away rather rapidly into the Arkansas River Valley on the south, and more slowly into the valleys of the White and Illinois rivers on the north. An arm of prairie or semi-prairie country reaches into the region up the Illinois Valley around Prairie Grove and Lincoln, and another near Maysville and Gravette. The caves in the Boston Mountain region proper are in sandstone; those of Madison and Benton counties are in limestone. The trees of the region are, for the most part, deciduous species which in certain limited areas are mixed with red cedar and pine.

Unless otherwise stated the mammals listed in this report are in the Museum of Birds and Mammals, University of Kansas, Lawrence, Kansas. The map of the region presented with this paper is based on the life-zone map by A. H. Howell, used as a frontispiece for his study of The Birds of Arkansas (1911).

LIST OF SPECIES

Didelphis virginiana virginiana Kerr. Virginia opossum. This is the commonest fur-bearer and is to be found everywhere throughout the region, appearing to be able to maintain its numbers fairly well in spite of extensive hunting. Next to the cottontail rabbit this species ranks first among the mammals of the section in the matter of highway mortality. Melanistic specimens are rather rare, although not as unusual as albinistic individuals. One adult female found in the summer of 1932 carried 13 young, with bodies about 5 inches long. Six of these were black and the remaining 7 normal. Winslow, 3; Mountainburg, 1.

Scalopus aquaticus machrinoides Jackson. Missouri Valley mole. Specimens from both Winslow and Fayetteville have been referred to this subspecies by Jackson, although they vary toward *pulcher*. Specimens from Ozark no doubt will be found referable to the latter race. Winslow, 10 (1, U. S. N. M.); Fayetteville, 7 (4, Univ. Ark.).

Cryptotis parva (Say). Little short-tailed shrew. Although taken only in and around Winslow, this shrew appears to be fairly common throughout the region. The farmers often refer to this and the next species as baby moles. Winslow and vicinity, 11.

Blarina brevicauda carolinensis (Bachman). Carolina short-tailed shrew. An individual was found by Ruby Black, August 28, 1934, dried and crushed on one of the streets of Winslow. Inquiry revealed that it had been caught in a mouse trap at a nearby house some days before and discarded as a "mouse." The subspecific identification therefore is problematical. Other specimens of *Blarina* from around Winslow have been reported to me and accurately described, but I have never been able to secure one. Winslow, 1, badly damaged.

Myotis grisescens A. H. Howell. Gray bat. This bat is very abundant in certain limestone caves throughout the northern part of the region. As many as 3000 have been observed in the breeding colony in Denney Cave, and probably as many or more are to be found in Cave Springs Cave and Crystal Cave. They have not been taken in mid-

winter at either of these three spots, but I did find them in small numbers at Bat Cave on July 6 and December 21, 1934. The specimens from Crystal Cave were taken by R. D. Harding, April 13, 1933, while they were still in hibernation. This locality has not been visited in summer, nor the Cave Springs Cave in winter. Crystal Cave, 168; Cave Springs Cave, 52; Bat Cave, northwest of War Eagle, 15; Denney Cave, 45.

Myotis sodalis Miller and Allen. Indiana bat. This bat is much less numerous than the preceding. The 3 specimens from Denney Cave were collected singly on June 11, 1933, March 30, 1934 and July 17, 1934. One specimen was taken in Bat Cave, July 6, 1934; the remaining 50 on December 21, 1934, when perhaps 500 were found hibernating in a single large dry room, hanging in scattered clumps of from 2 or 3 to 70. Denney Cave, 3; Bat Cave northwest of War Eagle, 51.

Pipistrellus subflavus subflavus (F. Cuvier). Georgian bat. This is by far the commonest bat throughout the Ozarks, and is to be seen almost anywhere on summer evenings. It winters in rather large numbers in Devil's Den, 10 miles west of Winslow, as well as in Bat Cave, northwest of War Eagle, and in Denney Cave. One or two may usually be found dormant in almost any moist cave visited in the summer, although the bulk of the individuals apparently desert the caves very early in summer. I have never found more than two individuals of this species hanging together, and this but rarely; they almost always hang singly and rather far apart. Many reports have come to me of "white" bats in the Arkansas caves, reports at first difficult to understand, but on December 21, 1934, we found a number of *Pipistrellus* in Bat Cave, northwest of War Eagle, that appeared to be pure white. When examined, however, they proved to be perfectly normal specimens covered with droplets of water, which in artificial light appeared snow white, or yellowish-white. During our visit at Ozark in July, 1934, we saw 4 individuals of this species, 2 each on successive nights, flying along the Arkansas River. More than 300 specimens were collected from the following localities: Bat Cave, east of Springdale; Bat Cave, northwest of War Eagle; Gregory Cave; Treasure Cave; Basset Cave; Denney Cave; Ferris Cave; various caves near Prairie Grove, and Winslow.

Eptesicus fuscus fuscus (Beauvois). Big brown bat. Single specimens have been taken from each of the 3 caves listed. The remaining 3 individuals were taken in buildings in Winslow. All were secured in summer except the individual from Bat Cave, northwest of War Eagle, taken December 21, 1934. I understand that Bat Cave north of Ozark formerly was densely populated with this species in the winter, and that they still winter there in reasonably large numbers. On the whole the species seems to be rather rare throughout the section. Bat Cave northwest of War Eagle, 1; Bat Cave north of Ozark, 1; Denney Cave, 1; Winslow, 3; Fort Smith, 3 (U. S. N. M.) and "mouth of Poteau River, Arkansas," 1 (U. S. N. M.).

Nycteris borealis borealis (Müller). Northern red bat. In addition to the specimens collected I have observed this bat at Mountainburg and Fayetteville. Here it is rather common and no doubt it occurs in reasonable numbers in summer throughout the region. Winslow, 18; Fort Smith, 2 (U. S. N. M., according to Harrison Allen, 1893).

Nycticeius humeralis (Rafinesque). Rafinesque bat. No doubt this species occurs in limited numbers throughout the Arkansas River Valley, and thus within the limits of this study in Franklin and Crawford counties. Fort Smith, 5 (U. S. N. M., according to Miller, 1897.)

Corynorhinus rafinesquii rafinesquii (Lesson). Rafinesque lump-nosed bat. There is known but a single specimen from the state; a skeleton, no. 5645 Univ. Kansas collection, taken at Mulberry, Crawford County, Arkansas, October 1, 1926, by R. E. McEntyre.

Corynorhinus macrotis (LeConte). LeConte lump-nosed bat. G. M. Allen (1916) listed a single specimen from Osage River (Carroll Co.?) Arkansas, Mus. Comp. Zool. collection. This appears to be the only actual record for the state.

Euarctos americanus americanus (Pallas). American black bear. Wayne Henbest, of Fayetteville and Winslow, tells me that he has collected and placed in the Zoology Department of the University of Arkansas, Fayetteville, tracks of this animal fixed in clay. He secured these at Bear Den Cave, 6 miles east of Lowell. The cave is reported to be filled with wallows and tracks of bears but no one seems to know how recent has been their occurence. Stories of the killing of black bears as late as 50 years ago circulate throughout the Ozarks, but there are available no definite data as to time of the actual extinction of the animal in the region.

Procyon lotor hirtus Nelson and Goldman. Missouri Valley raccoon. No specimens of this fairly common fur-bearer were collected.

Mustela primulina Jackson. Missouri weasel. The species is present but apparently it is rather rare. Fur dealers at Winslow secure one or two skins each year, while a few more are bought at Ozark and Huntsville. Winslow, 2; Crawford Co., 10 miles south of Winslow, 1; Fayetteville, 1 (Univ. Ark. coll.).

Mustela vison mink (Peale and Beauvois). Mink. The only available museum specimen is that of a mounted individual from Alix, Arkansas (near Ozark), in the University of Arkansas collection, taken January 7, 1931 by a Mr. Melton. Although this area is in the zone of intergradation between *mink* and *letifera* (Hollister, 1913), it seems better to refer the specimen examined to the former race. The species occurs rarely throughout the entire section. I have examined skins in the hands of fur dealers from south of Winslow, in Crawford County, and from near West Fork. Dealers also report occasional purchases of skins from around Huntsville.

Spilogale interrupta (Rafinesque). Prairie spotted skunk. No museum specimens are available. Claude Prater, fur dealer at Brentwood, north of Winslow, who purchases furs from a wide territory in Washington and Madison counties, had about 20 skins in his storeroom at the end of December, 1934. These I examined carefully and there is no doubt that the spotted skunks of this region should be referred to the above species.

Mephitis mesomelas mesomelas Lichtenstein. Louisiana skunk. No museum specimens are at hand, but the species is very common throughout the region. Although evidently belonging to this race (specimens from Marble Cave, Stone County, Missouri, just across the state line were thus considered by Howell, 1901) the local specimens are extremely variable, with a very high percentage showing white in the tail, and white often predominating over the black.

Vulpes fulva (Desmarest). Eastern red fox. A very old male was killed by dogs near Winslow, July 4, 1934. The skeleton of this fox is the only specimen available, although both this species and *Urocyon* have become very common since the year-round closed season in Arkansas went into effect.

Urocyon cineroargenteus cineroargenteus (Schreber). Eastern gray fox. The gray fox is extremely common throughout this area, especially in southern Washington County and east through Madison and northern Franklin counties. It is protected like the red fox, which it outnumbers about 5 to one. Museum specimens are limited to one adult female skeleton from near Winslow, and 2 immature individuals from the same locality, in captivity at Lawrence and alive at this writing.

Canis nubilus (Say). Timber wolf. The proper name for the local wolf is somewhat in doubt. It is highly probable, however, that the species is *nubilus*. Although rare, this animal still ranges through southern Washington and Madison counties, the northern parts of Franklin and Crawford counties, and through the more inaccessible portions of the Ozarks. For the past 6 years from 1 to 8 pelts have been purchased each season by fur buyers in the Winslow region. Probably one-fourth of the skins have been in the black phase. There are no museum specimens.

Lynx rufus rufus (Schreber). Bobcat. A tanned skin in my private collection, from

Crawford County, south of Winslow, is the only specimen of which I have knowledge. The species is rather common, however, although difficult to secure. The Arkansas Game and Fish Commission formerly paid a bounty of $2.50 per scalp for these animals, at which time numbers were taken, but trappers now cannot be induced to secure specimens for a reasonable sum. The range of the bobcat includes all of the Ozarks, although apparently the animal is more common in the rougher, wilder portions of the hills and rarer in the valleys. The bobcat is very common at times and is known to gather in numbers along with hawks and owls in and around the large robin roosts which are of almost yearly occurrence near Winslow. I have seen bobcats in these roosts at night and have repeatedly heard them make their kills (Black, 1928).

Marmota monax monax (Linnaeus). Southern woodchuck. Marmots are extremely common throughout the region except in the Arkansas River Valley, where they are known, but are considered rather rare. Winslow, 4; West Fork, 2; Fayetteville, 3 (Field Mus.).

Tamias striatus venustus Bangs. Southwestern chipmunk. Chipmunks are very common throughout the Ozarks. The only specimen observed at Ozark was in the bluff along the Arkansas River, but it is reported as normally common there. Sight records include Huntsville, Ozark, Mountainburg, and Gravette, in addition to museum specimens as follows: Winslow, 12; Fayetteville, 4.

Sciurus carolinensis carolinensis Gmelin. Southern gray squirrel. The species is fairly common, and sometimes abundant, throughout the region. One specimen, otherwise normal, is remarkable in having a bright rufous tail. Several other individuals of this type were reported as being killed in 1932 out of two small hollows west of Winslow, where the specimen that I secured was taken. The black phase of this species is practically unknown from this region. The few albino squirrels that I have seen from the Ozarks have all proven to be of this species. Winslow (Crawford and Washington counties), 10.

Sciurus niger rufiventer (Geoffroy). Western fox squirrel. Fox squirrels are common throughout the area, preferring the denser growths of timber. The black phase, or intermediate pelages, is not infrequent. Winslow and vicinity, 8.

Glaucomys volans volans (Linnaeus). Small eastern flying squirrel. Of the 15 specimens of flying squirrels collected, probably 8 should be referred to this race, all from the Winslow region.

Glaucomys volans saturatus Howell. Southeastern flying squirrel. In his revision of the group, Howell (1918) wrote: "In the Boston Mountains (in this instance around Stilwell, Oklahoma) intergradation (between *volans* and *saturatus*) occurs." This is quite true of the Boston Mountains of Arkansas as well. Specimens from the Winslow region, although all purely intermediate, clearly show that those to the south of the transverse chain of hills, below 1500 feet, are closer to *saturatus* than to *volans*, while specimens from above 2000 feet, and north of the divide at all elevations, seem more closely related to the race *volans*. If any clear geographical line of demarcation is to be erected for differentiating the ranges of the two races it might be placed at 1600 feet and below on the southern boundaries of Washington and Madison counties. Unfortunately, specimens from Ozark and Gravette are not available. The species is considered rare along the Arkansas River Valley, but common elsewhere in the region. Of the specimens collected, 7, all from the Winslow region, seem best referred to this race.

Geomys breviceps breviceps Baird. Louisiana pocket gopher. This species is known to occur on both sides of the Arkansas River, and it has been reported to me from Ozark, Mulberry and Van Buren. It does not seem to be as common as is generally the case with animals of this group, and I have not secured examples. Known specimens are limited to 7 from Fort Smith (U. S. N. M.) listed by Merriam (1895).

Reithrodontomys fulvescens aurantius (Allen). Golden harvest mouse. Only 5 specimens of this mouse were collected, 2 from the same trap on successive nights. Winslow, 4; Huntsville, 1.

Peromyscus maniculatus ozarkiarum Black. Ozark white-footed mouse. This is by far the most common mouse and perhaps the most common of all the mammals in the region. A specimen secured by Henry Mills, of Winslow, 7 miles west of Stilwell, Oklahoma, December 26, 1934, seems clearly to belong to this race, and thus its known range is extended definitely west into Oklahoma. Winslow and vicinity, 49; Gravette, 2; Huntsville, 2.

Peromyscus leucopus leucopus (Rafinesque). Southern white-footed mouse. Huntsville, 2; northeast of Mountainburg, 1.

Peromyscus leucopus noveboracensis (Fischer). Northern white-footed mouse. The subspecific separation of these two forms, like the case of the flying squirrels, has offered a problem of much interest in connection with the study of the mammals of the northwest Arkansas region. After all the specimens were carefully compared with typical material supplied by the United States National Museum I have concluded that the specimens from Huntsville, although intermediate, should be considered as belonging to the southern race. The specimen from Mountainburg is almost typical of *leucopus*. Those from Fayetteville clearly belong to the subspecies *noveboracensis*, as do most of those from Winslow; but the latter in certain instances show considerable similarity to the southern form. Winslow and vicinity, 26; Fayetteville, 3.

Peromyscus boylii attwateri (Allen). Attwater white-footed mouse. This interesting form appears to be quite common in favorable localities throughout the region. At Ozark, for instance, during an exceptionally unfavorable season, we secured 5 from a line of 35 traps in as many nights. Signs of their presence were abundant all along the cliff bordering the Arkansas River at Ozark, and the animals have recently been found to be just as abundant near Winslow, where I secured 3 in one night. It is common at Stilwell, Oklahoma, and has been taken at Batesville, Arkansas (Osgood, 1909), so that it must range all across the region in question. Winslow, 7; Ozark, 5.

Peromyscus nuttalli aureolus (Audubon and Bachman). Southern golden mouse. Previous knowledge of the distribution of this mouse indicated that it was to be found in Arkansas only in the lower elevations (Osgood, 1909), but I have found it at elevations from 1850 to at least 2100 feet, and probably at 2200 feet near Winslow. In the fall of 1932, 7 miles northeast of Winslow, Henry Mills secured 10 of these mice in 16 trap nights. They were all taken from a single slope where they were nesting in tangled wild grape vines from 8 to 15 feet high. At that time nests were to be found at very short intervals along this dark, densely wooded slope, but a year later this colony was completely deserted. The other specimens were secured in an old pasture overgrown with blackberry and wild grape vines, and some small trees, and just beyond the limits of the village of Winslow. Winslow, 19.

Sigmodon hispidus hispidus Say and Ord. Northern cotton rat. Although intermediate between this race and *texianus*, all the specimens taken seem referable to the typical form. A. H. Howell has so considered one specimen in my private collection from Winslow. This species is very common at Winslow and Gravette, and is reported as normally common at both Ozark and Huntsville. Winslow, 32; Ozark, 1; Gravette, 2.

Neotoma floridana attwateri (Mearns). Attwater pack rat. This animal is very common throughout the Ozarks. I have encountered indications of its presence in a large majority of the caves visited, and found abundant signs, although always old, along the cliffs at Ozark. I frightened a large female, nursing 4 young, from her nest on a rock ledge far back in Delap Cave, near Prairie Grove, June 12, 1933. She escaped, carrying the young clinging to her sides, but she did not appear to be alarmed especially by our presence. Her nest was on a narrow ledge, about 4 feet from the floor of

the cave, probably 200 yards from the entrance. It was not the usual rubbish heap of these animals, but a neat, bird-like nest-cup made of grasses, with an inside diameter of about 5 and an outside diameter of not more than 8 inches. On revisiting the nest a year later I found that the tenant was away but the nest had been freshly relined and a sort of roof of grass had been built over it, after the fashion of the ovenbird or Carolina wren.

Pitymys nemoralis (Bailey). Woodland pine mouse. Although specimens are available only from Winslow, this species should be found to occur throughout the region. I have found old runs, apparently belonging to this species, around Huntsville and Ozark. Near Winslow specimens have been secured by trapping in burrows under decaying logs, in runs in tall blue grass, and in burrows through decaying hay, the latter situation proving by far the most fruitful. One specimen was taken by Hugh Phillips as it crossed the barn lot at his home near Winslow at mid-day, July 9, 1934, during the extreme period of heat and drought prevailing at that time. This activity away from cover and under conditions of such extreme heat (temperatures were daily over 100 degrees) evidently indicates an emergency migration, at least for this individual. Winslow and vicinity, 17.

Ondatra zibethica zibethica (Linnaeus). Common muskrat. No museum specimens of muskrat are available, but the animals are taken every season along the White River from Fayetteville north, at Huntsville and at Ozark. One or two specimens have been taken at Winslow, although the water there is inadequate to support the species under normal conditions. I have recently examined a pelt taken at Brentwood. This animal is said to be extending its range each year into the smaller streams and is now fairly well established at West Fork, where it was unknown a few years ago.

Rattus norvegicus (Erxleben). Norway rat. No specimens have been preserved, but as elsewhere this species is a serious pest around barns, feed stores and granaries.

Mus musculus musculus (Linnaeus). House mouse. This species has been taken (although not preserved) at Ozark, Huntsville and Fayetteville, far from houses, and seems to thrive in open fields in competition with *Peromyscus*. Winslow, 24.

Lepus californicus melanotis (Mearns). Great plains jack rabbit. Although as yet no specimens have been secured to substantiate this record, I am including this form because of the abundance of evidence indicating its presence in the region. It is known to be locally common around Prairie Grove and Lincoln, Washington County, and around Maysville, Benton County. It also has been reported from Springdale, Evansville, Summers, Winslow, and Mountainburg. It seems to have increased somewhat within the last 3 years in the semi-prairie portion of the region and now appears to be well established in that section.

Sylvilagus floridanus alacer (Bangs). Oklahoma cottontail. Cottontails are extremely common throughout the region and subject to a very high mortality on the highways, which take a far greater toll than do hunters. Winslow, 2; Mountainburg, 1.

Sylvilagus aquaticus aquaticus (Bachman). Swamp rabbit. Hunters inform me that this species is locally common along the White River near Springdale and Elkins, and near Prairie Grove on the Illinois River. These points vary from 900 to 1300 feet in elevation, and are all within the Upper Austral Zone. Fayetteville, 2 (coll. Univ. Ark.).

Odocoileus virginianus virginianus (Boddaert). Virginia deer. It seems reasonably certain that the native deer were exterminated in the region under consideration long ago. The last record from Washington County, of which I have knowledge, was that of an individual killed north of West Fork during the winter of 1890–91. In recent years deer have been introduced once more and a herd of considerable size now ranges in the Ozark National Forest in Washington, Crawford, Madison and Franklin counties.

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BIOLOGY OF THE SIBERIAN WEASEL

By A. S. Fetisoff

While in the Irkutsk and Ussolsk districts, and in the vicinity of Lake Baikal, during the autumn and winter, I took the opportunity to investigate the habits of the Siberian weasel (*Kolonocus sibiricus* Pallas). In my efforts to obtain stomachs of this species, for analysis of contents, I was aided by S. Krikunoff, Director of the Experimental Farm, Sludyansk District, and by I. Ryaboff, manager of the receiving depot for furs, Iro, Selenguinsk District. Some stomachs also were received from Kazachinski, Lensky District. In all, 114 stomachs have been available, 79 of males and 35 of females. In addition, excavation of burrows has assisted me to a better knowledge of the food habits of the species.

In the areas investigated this weasel is found mostly in three general types of habitat. The first comprises a forest-steppe type of country southwest of Transbaikalia and in the Selenguinsk District, in which there are scattered peaks on an extensive plain. The latter is grassy, and the more elevated parts are partially covered with larches, pines, birches, and brush. The second type of habitat extends southeastward of Lake Baikal. It also is forest-steppe in type, but the lowlands are given over more to agriculture and less to grazing, and in the forest birch predominates, while there are fewer larches. Large numbers of weasels occur throughout this district. The third or forest-zone type of habitat comprises the Great Hamar-Daban Range, in the Selenguinsk, Kabansk, and Sludyansk districts, with elevations reaching 200 meters. The country is extremely rough and there are river valleys of all sizes covered mostly with firs, as well as larches, aspens, birches, and willows. Here weasels frequent the banks of streams and rock slides inhabited by *Ochotona*, but for the most part they avoid the steeper slopes.

The weasels live in burrows, often beneath tree roots, usually appropriating one dug by other mammals, or in the hollows of fallen trees. Burrows investigated were from 0.6 to 4.2 meters in length, the depth varying from 0.2 to 1.3 meters. A nest is arranged in the center or at the end of a burrow, and here there are usually the feathers of birds and pelts of mammals that have been eaten. A single animal usually has a main burrow and several temporary shelters scattered over its range, which may extend for several kilometers. I have found that a mature individual may have as many as 5 of these, while younger ones have fewer, but I have been told that the adults may have even more.

My work was done in the colder months, and nearly always I found that small mammals and birds that had been captured were stored in the burrows. In one I found 6 entire, 2 partly eaten, and 2 pelts of *Microtus*, 1 pelt of *Eutamias*, and the feathers of several birds. The greatest number of small rodents found in one burrow numbered 16, all being *Apodemus*.

TABLE 1

Food remains in 114 stomachs and 36 burrows of the Siberian weasel

KIND OF FOOD	NO. OF TIMES PRESENT	PLACE FOUND
Sciurus (Mammalia)	1	Stomach
Eutamias	8	Stomach
Eutamias	8	Burrow
Citellus	1	Stomach
Citellus	1	Burrow
Apodemus (2 species)	26	Burrow
Rattus	3	Burrow
Clethrionomys (2 species)	8	Burrow
Arvicola	4	Burrow
Stenocranius	9	Burrow
Microtus (3 species)	13	Burrow
Cricetulus	1	Burrow
Ochotona (2 species)	7	Stomach
Sorex	2	Stomach
Talpa	2	Burrow
Mustela	1	Burrow
Meles	1	Stomach
Nucifraga (Aves)	1	Stomach
Nucifraga	1	By trail
Garrulus	1	By trail
Parus (2 species)	3	Burrow
Turdus	1	Burrow
Saxicola	1	Burrow
Sitta	2	Burrow
Acanthis	1	Burrow
Acanthis	1	By trail
Pyrrhula	1	By trail
Pyrrhula	1	Burrow
Dryobates	1	Burrow
Tetrao	2	By trail
Lyrurus	5	By trail
Lyrurus	2	Burrow
Tetrastes	1	Burrow
Tetrastes	3	Stomach
Tetrastes	4	By trail
Perdix	3	By trail
Perdix	2	Stomach
Perdix	1	Burrow
Anas	1	Burrow
Gobio (Pisces)	3	Burrow
Leuciscus	1	Burrow

Of the stomachs examined, 21 were empty, and of the remaining 93, there were 23 that were taken in October, 49 in November, 16 in December, 1 in January, 2 in February, and 2 in June. Table 1 is based not only upon

stomach contents, but upon the contents of 36 burrows as indicated, and upon remains found beside weasel tracks. It should be noted that the burrows sometimes contained feathers of birds that do not occur in these regions during the winter, so they must have been captured during the summer. Only those items of certain identification are mentioned.

In this table it will be noted that there are no such items as frogs, eggs or berries, nor other sorts of food obtainable only during the warmer months. The presence of badger hair, in large quantity, can reasonably be explained only by the presumption that the weasel found an individual already dead.

It is true that this weasel does some harm to game birds, and occasionally to poultry, but it is clear that it must be considered beneficial on the basis of the rodents destroyed. The weasel must be a factor in the control of the chipmunk, and this genus is considered to be somewhat of a pest in the agricultural sections where it occurs.

The Siberian weasel occasionally is abroad during the day, but it is chiefly crepuscular and nocturnal. The average distance covered during a night's hunting is 3 or 4, or occasionally as much as 8, kilometers, the distance travelled probably being in relation to the depth and softness of the snow upon the ground. During particularly cold spells weasels do not forage abroad, but feed upon the supplies already stored in the burrows. In one instance I determined that an individual did not return to its home burrow for the space of 4 days.

In its search for food the Siberian weasel tunnels beneath the snow, doubtless utilizing all rodent burrows which it encounters there, and often emerging on the surface. Naturally it encounters competitors and enemies, and I once watched a fight between a weasel and a fitch (*Putorius eversmanni*), in which the latter was victorious. Only rarely does a weasel climb above the ground.

It is the opinion of Cherkasoff and other hunters that the males and females of the Siberian weasel live together during the winter, but my observations failed to confirm this claim. It has been my experience that during this season the sexes remain entirely segregated, utilizing separate burrows.

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THE HIBERNATION OF CERTAIN BATS IN SOUTHERN MINNESOTA

By Gustav Swanson and Charles Evans

Several caves near St. Peter in Southern Minnesota were found during the winter of 1933–34 to harbor 4 species of bats, one of which, the pipistrelle (*Pipistrellus subflavus*), had not previously been recorded for the state. A second species, *Myotis keenii septentrionalis*, had previously been reported from Minnesota only on the basis of 3 specimens taken at Elk River (Bernard Bailey, 1929). A few individuals of the little brown bat, *Myotis lucifugus*, were also found; but the species occurring in the greatest numbers was the big brown bat, *Eptesicus fuscus*. This is of interest because *Eptesicus* is not ordinarily regarded as a cave bat, nor is it usually considered to occur regularly in Minnesota during the winter.

The caves were visited 3 times; on January 4, 1934, by William Wilber and Evans, on February 12 by W. J. Breckenridge, Swanson, and Evans, and on March 25 by L. Fischer and Swanson. The bats were counted on February 12, when they occurred in the following numbers: *Eptesicus fuscus*, 240; *Pipistrellus subflavus*, 15; *Myotis lucifugus*, 11; and *Myotis keenii septentrionalis*, 4. The big brown bats were found in all of the 3 caves investigated, but at the time of our visits in February and March the other 3 species were confined to one of the caves. On the January trip a few little brown bats also were present in another cave.

The 3 caves all were obviously man-made, dug in the St. Peter sandstone, which outcrops in this vicinity. They were excavated many years ago, however, and the present local residents do not seem to be acquainted with the original purpose for which they were made. The cave in which most of the big brown bats were found was described in a previous note (Evans, 1934). It was 6 to 8 feet high, about as wide, and extended approximately 150 feet into the sandstone. Originally this cave was continuous with the one in which the pipistrelles were found, but a cave-in had completely separated them. The pipistrelle cave was similar to the one described above throughout the first 50 feet of its extent, but thereafter the floor became very uneven and the passageway widened into a room with irregular walls and ceiling, the result of repeated cave-ins. The third cave had several entrances about the size of doorways. It consisted of several rooms, 12 to 14 feet high, connected by hallways. A fourth cave, near Jordan, Minnesota, was visited only on March 25, and 42 bats were found in it. This cave was used earlier by a local brewery for storing its products.

Our observations on the bats in these caves indicate that they are more or less active throughout the winter. This is in contrast to the impression created by several writers, among them Vernon Bailey (1933). His legend below a photograph of bats in Colossal Cavern reads: "(Fig. 16) These little upside down bats hang all winter by their hooked hind claws, wholly

torpid, cold, and motionless from the first of October until the warm days of April or May." Elsewhere, in speaking of the pipistrelles, he wrote: "The bats' fur was damp and beady with condensed moisture, and their bodies were as cold as the air, rigid and apparently lifeless. Here they had hung all winter by the well-curved hind claws hooked over rough places in the roof." When first seen on February 12 several of the pipistrelles in the St. Peter cave appeared just as Bailey has described, but an hour later, when we returned to photograph them, one already had flown away, and another was moving about, although we had been careful not to disturb them. The fact that several other bats were found flying about soon after we had entered the cave was an indication that their sleep was very easily disturbed.

On an earlier visit to the cave, Wilber had found no pipistrelles in the localities in which we encountered them. On January 4 no bats were seen in one of the caves which on February 12 contained over 50 big brown bats. As mentioned above, individuals of the genus *Myotis* were found on January 4 in a cave which in February had only *Eptesicus*. Obviously there had been far too much activity to be in accord with the picture of deep hibernation presented by several writers.

A note from Mr. Wilber written December 11, 1934, gives additional evidence of the movement of the bats. A small cave about one-quarter mile from the other caves mentioned is visited quite regularly, almost daily. We quote from his letter: "Have not been up to the bat caves since seeing you, but found one bat in my cave some days ago. Then a day or so later I found I had two. Then yesterday three were there so I may have a good sized family after awhile. P.S. (December 12.) Four bats today."

The degree of torpidity varied considerably in different individuals. Some, as already mentioned, flew with very little provocation, while others required 45 minutes or more in daylight to arouse them.

Observations also were made on the respiratory rate of some of the bats. One big brown bat hanging in a torpid condition was breathing irregularly, and there were long periods of complete cessation of movement. These periods of apnea lasted from 3 to 8 minutes, averaging 4.6 minutes over a period of one-half hour. Breathing periods generally lasted 3 minutes or less, during which the rate of respiration was from 23 to 48 per minute. This bat was subsequently aroused intentionally by warming and rough handling. Its respiratory rate rose to 200 per minute before it was able to fly. On March 25 we observed the respiratory rate of an undisturbed big brown bat. The bat was not breathing when found, but after two and one-half minutes it inhaled twice. It then stopped breathing for 3 minutes, after which the observation ceased. A little brown bat respired 18 times in 20 seconds; it then inhaled at a slow rate for 155 seconds, and stopped for 220 seconds. The difference in the degree of torpidity exhibited by different individuals indicates that the bats are not in a constant state of hibernation.

The insect population of the caves was adequate to provide a ready supply

of food for the bats should they desire it. Mosquitoes were especially abundant, and moths and hemipterans also were common. As an indication that the bats were utilizing this available food, two facts were significant. Bats collected on each of the 3 trips dropped large numbers of well-formed feces within a few hours of their capture, and on one occasion microscopic examination showed that chitin was present.

The activity and apparent feeding of these bats during the winter leads us to disagree with those who have assumed that so-called hibernating bats remain in constant dormancy throughout the winter. Our observations on bats tend to parallel those of Johnson (1931) on the 13-lined ground squirrel. He found that the hibernating individuals of the latter awaken between periods of torpor varying in length from 1 to 18 days. Between the periods of torpor the animals remained awake for intervals which averaged one day in length. They awakened with a full bladder and rectum, voided, and ate a small amount of food before returning to a state of torpor. Johnson's observations were the result of several experiments, each with 20 animals kept in a refrigerator.

Attempts were made to determine the body temperature of the bats in relation to that of the cave, but on the February trip only an ordinary household thermometer was available. On March 25, however, we used an accurate laboratory thermometer as well as a Leeds and Northrup potentiometer with Centigrade scale, which was loaned by the Division of Entomology through the courtesy of Dr. A. C. Hodson of that department. With the fine thermocouple junction it was possible to take the temperature of a small point quickly and with little or no disturbance of the bats. For measurements where they could be used equally conveniently the laboratory thermometer and the potentiometer checked very closely. The readings have been transposed from Centigrade to Fahrenheit.

On February 12, when the outside temperature during the period of our stay varied from 35 to 45 degrees, the temperature within the caves was quite constant. The pipistrelle cave varied from 45 degrees near the entrance to 48 degrees at the deepest part. The temperature of the cave containing the majority of the big brown bats was 42 degrees at the point where the largest mass of bats was hanging, about 100 feet from the entrance. A thermometer, thrust into the mass of bats after they had been disturbed slightly by our lights and were breathing quite regularly, registered 98 degrees. At this time, however, the bats were quite thoroughly aroused and several had flown away.

On March 25 the outside temperature was 40 degrees while that just inside the pipistrelle cave was 45 degrees and at its deepest part the temperature was again 48 degrees. The thermocouple junction was placed against the back of a big brown bat, and the potentiometer scale showed no deflection from the room temperature of 48 degrees. This bat was undisturbed, but

when it had been disturbed enough so that the junction could be placed in its mouth the oral temperature was 54.4 degrees. It is felt that this rise was actually a temperature change resulting from the disturbance of the bat, rather than a difference in the temperature of the mouth and skin of the back, because it was determined later that the thermocouple junction on the back gave a temperature which agreed closely with that measured orally. For example, a bat which had been thoroughly aroused and brought indoors into a room temperature of 69 degrees had a body temperature of 96 degrees as measured by the potentiometer both orally and on the skin of the back.

The temperature of two pipistrelles hanging together was taken by inserting the thermocouple junction between them. The cave temperature was 48 degrees, and the initial temperature of the bats was 50 degrees, but as they were gradually aroused by the slight disturbance which we caused, their temperature gradually rose to 61 degrees, soon after which one of the pipistrelles flew away.

In the second cave the room temperature near the largest group of big brown bats was 44 degrees. Special effort was made to take body temperatures both externally and by mouth before they had been disturbed or aroused appreciably, and under those conditions no change from the room temperature was measurable by either method, although the potentiometer is accurate to within one-half degree.

A few of the big brown bats were taken back alive and were divided into two groups. Some were placed in a temperature cabinet kept nearly constant at 45 degrees. With the aid of Mr. David Lindgren of the temperature rooms of the Division of Entomology, thermocouples were arranged so that the temperatures of both cabinet and bat could be read on the potentiometer scale without any disturbance to the animal, as it was not necessary even to open the cabinet door. The bats were kept in a light-proof container within the cabinet. Under these undisturbed conditions the body temperature of the bats, as measured on the skin, was almost exactly equal to that of the cabinet. Sometimes it was one-half or one degree higher than that of the cabinet.

Another group of bats was placed in a cabinet kept several degrees below freezing. In this case it was found that the temperature of the bats was always from one and one-half to 4 degrees above the cabinet temperature, which measured 27.6 degrees. According to these observations the temperature of the living bats, even in undisturbed dormancy, did not fall below 29.3 degrees. A colder temperature cabinet was not available for further tests, but it is believed that the bats would die if subjected to temperatures lower than this.

These big brown bats, taken March 25, were kept in the 27.6- and 45-degree temperature-cabinets to determine how long their hibernation could be prolonged. After 3 weeks they were still alive, but by May 1 all had died. Death may have resulted from hunger, thirst, or the enforced prolongation

of the inactivity. The humidity in the cabinets was quite high; probably about equal to that in the caves.

In this connection it may not be amiss to present some other winter records of the occurrence of bats in Minnesota, because few have appeared in print. In the winter and spring of 1932, Dr. Ralph W. Macy secured a number of bats from a large furniture store in St. Paul. These bats had been in the building all winter, and in the evenings would fly about in the store, to the annoyance of the management. All but one of the individuals captured proved to be big brown bats, of which one was taken January 31, one March 10, one March 19, three March 26, and one March 28. On April 9 a single red bat, *Nycteris borealis*, was secured. An additional big brown bat was taken March 1, 1932, at a theatre in Minneapolis, and on December 7, 1934, a student brought to one of the writers another living specimen of the same species taken inside the library building of the university. All of these bats were active.

We are grateful to Colin C. Sanborn of the Field Museum for confirming the identification of the specimens of *Myotis keenii septentrionalis*. The specimens of all species mentioned are in the collection of the University of Minnesota Museum of Natural History.

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GEOTROPIC BEHAVIOR ON A SLOPING PLANE OF ARBOREAL AND NON-ARBOREAL RACES OF MICE OF THE GENUS PEROMYSCUS

By Frank H. Clark

When a mouse or rat is placed on a sloping plane and phototropic stimuli are eliminated, the animal does not climb vertically up the surface, but creeps at an angle; and the steepness of the angle depends upon the slope of the inclined surface and the genetic constitution of the strain used (Crozier, W. J., and G. Pincus, Analysis of the geotropic orientation of young rats, VIII, Jour. Gen. Physiol., vol. 16, pp. 883–893, 1933.) The present study is concerned with the angles at which several species and subspecies of mice of the genus *Peromyscus* climb on an inclined surface.

The inclined plane used for this study measured 3 by 4 feet in size and was constructed of wooden boards over which was tightly stretched a wire screen of 14 meshes per inch. A pointer on the arm of a pantograph was held over the mouse as he climbed the sloping plane and his exact trail was recorded on a piece of graph paper by the pantograph. The angle of slope of the plane from the horizontal was made 20, 40, and 60 degrees in several tests with each mouse.

The young mice were tested when 11 or 12 days of age, at which time their eyes were still closed. The study was made in a dark room, the only source of light being a one-watt neon bulb hung vertically above the plane.

In climbing the slope of the inclined plane the mouse may progress steadily in a straight line, but more frequently the animal climbs in a zigzag manner, each step being at approximately the same angle with the base of the plane. The orientation angles were measured from the base of the sloping plane, and each change in direction was measured as a separate angle. The number of orientation angles obtained from each mouse at each inclination of the plane varied from 15 to 35 and depended upon the strength of the animal. The mean orientation angles and their probable errors, weighted for number of observations, for the several subspecies at the 3 inclinations of the sloping plane (20, 40, and 60 degrees) are given in table 1.

Three species of *Peromyscus* were used in these experiments; *Peromyscus maniculatus*, *P. boylii* and *P. californicus*. All of the animals used were the immediate descendants of wild-caught stocks. The widespread species, *P. maniculatus*, is represented by 4 subspecies: *artemisiae*, a semi-arboreal form from the two localities of Thompson and Polson, Montana; *osgoodi*, a non-arboreal form from Taylor, North Dakota; *nebrascensis*, a non-arboreal mouse from Kelso, Nebraska; and *bairdii*, a prairie race collected at Onaga, Kansas, and at Lake Village, Indiana. The semi-arboreal species *P. boylii* is represented by 2 stocks of the single subspecies *rowleyi*, trapped at Summer haven in the Santa Catalina Mountains and at Miller Canyon in the Huachuca

Mountains, Arizona. Most of these stocks were collected on expeditions financed by funds supplied by the Carnegie Institution of Washington. Others of the stocks were collected by B. T. Ostenson, Paul Hickie, and H. M. Smith.

The statistical treatment of the data in this experiment was done by Margaret Liebe.

Two stocks of *Peromyscus maniculatus bairdii* from different localities were used and they differed so much in performance at the 60 degree slope that they are listed separately in the table. These two stocks of *bairdii* give similar orientation angles at 20 and 40, but at 60 degrees the Onaga stock travelled at an average angle 7 degrees steeper than the Lake Village animals. This difference is nearly 9 times its probable error and therefore significant.

TABLE 1

Mean orientation angles in degrees and their probable errors of several subspecies of young Peromyscus on a sloping plane

	20° SLOPE	40° SLOPE	60° SLOPE	NO. OF ANIMALS TESTED
Peromyscus maniculatus bairdii, Onaga	40.51 ±0.85	57.01 ±0.52	70.33 ±0.48	10
Peromyscus maniculatus bairdii, Lake Village	38.60 ±1.19	53.28 ±0.77	63.27 ±0.64	7
Peromyscus maniculatus bairdii, Onaga + Lake Village	40.03 ±0.71	55.72 ±0.44	66.99 ±0.41	17
Peromyscus maniculatus osgoodi, Taylor	random	52.96 ±0.51	69.85 ±0.41	8
Peromyscus maniculatus nebrascensis, Kelso	41.35 ±0.64	51.56 ±0.53	68.64 ±0.46	7
Peromyscus maniculatus artemisiae, Thompson + Polson	43.96 ±0.38	57.29 ±0.34	76.98 ±0.21	13
Peromyscus boylii rowleyi	44.46 ±0.60	57.22 ±0.54	72.94 ±0.44	7
Peromyscus californicus parasiticus	45.38 ±0.65	59.89 ±0.70	77.47 ±0.45	2

Thirteen of the 17 *bairdii* tested showed only random movements at the 20 degree slope. None of the 8 tested mice of another non-arboreal form, *P. m. osgoodi*, exhibited orientation at 20 degrees. In fact they showed numerous downward movements at 40, and even at 60 degrees. One of these mice consistently crawled downward at 40 degrees of slope. All 7 animals of the other non-arboreal form, *P. m. nebrascensis*, gave orientation angles when the inclined plane was set at 20 degrees. At 40 and 60 degree slopes, the 3 non-arboreal races, *bairdii*, *osgoodi*, and *nebrascensis* produced similar orientation angles. At the 20 degree slope *nebrascensis* was able to orientate, while *bairdii* and *osgoodi* showed little or no orientation. This difference seems to be the most outstanding one in comparing these 3 non-arboreal races, but may be of doubtful significance because of the small number of animals concerned.

The semi-arboreal *P. m. artemisiae* gave quite different results from those described above for the 3 non-arboreal subspecies. All 13 of the mice of this race were sensitive to a slope of 20 degrees, differing markedly in this respect from *P. m. bairdii* and *P. m. osgoodi*. Moreover, *artemisiae* produced higher average orientation angles at 20, 40 and 60 degree slopes than any of the non-arboreal races. The differences were especially great at the 60 degree slope, all being more than 12 times their probable errors and thus highly significant. The differences at the 20 degree slope were slight, while at the 40 degree inclination *artemisiae* gave significantly higher orientation angles than either *osgoodi* or *nebrascensis*.

Seven mice of another species, *P. boylii rowleyi*, were tested. These mice are semi-arboreal in habit and somewhat larger in size than *maniculatus*. All 7 of them gave consistent orientation angles at a slope of 20 degrees, and the mean of these for the 7 animals was higher than those obtained for the non-arboreal subspecies *P. maniculatus bairdii* and *P. m. nebrascensis;* the differences, however, were slight. Likewise, at an inclination of 40 degrees, the mean orientation angle for *P. boylii rowleyi* was higher than those of the 3 non-arboreal forms, being significantly higher than those shown by *osgoodi*, by *nebrascensis*, and by *bairdii* from Lake Village. Again, at the 60 degree slope the mean orientation angle of *P. boylii rowleyi* was higher than those of the non-arboreal mice. The difference from the mean of the *bairdii* is 5.95 $\pm$0.60 degrees.

A single litter of another semi-arboreal form, *P. californicus parasiticus*, was tested. Unfortunately, only this single litter of 2 animals was available for study. This species, like *P. b. rowleyi*, is semi-arboreal in habits and the mice are nearly as large as rats. These 2 mice were sensitive to a slope of 20 degrees and produced higher orientation angles at all 3 slopes than any of the non-arboreal subspecies.

Several points of probable significance in the results given above should be emphasized. The 3 semi-arboreal races tested gave higher orientation angles at slopes of 20, 40, and 60 degrees than either of the 3 non-arboreal subspecies. The values at the 20 and 40 degree slopes for the 3 arboreal forms are nearly identical while at the 60 degree inclination the average orientation angles of *artemisiae* and *californicus* were practically the same (76.98 and 77.47) and somewhat higher than that of *rowleyi* (72.94). The value for *rowleyi* was higher, however, than that of any of the non-arboreal races. It is interesting to note that these 3 semi-arboreal races, although each belongs to a different species, produced similar orientation angles. All 22 of the arboreal mice were sensitive to an inclination of 20 degrees, while only 11 of the 49 non-arboreal mice reacted to this slope. The remainder wandered at random on the plane.

Crozier and Pincus have pointed out that for a critical study of geotropism, inbred strains should be used. The purpose of this study, however, was to

demonstrate, if possible, whether or not semi-arboreal and non-arboreal races of *Peromyscus* differ in geotropic behavior. Although the variability in this study was very high (coefficient of variation 7 to over 20 per cent), it is believed that the consistent differences in geotropic behavior between semi-arboreal and non-arboreal races of *Peromyscus* have some inherent physiological or structural basis correlated with the habits of these races.

Great variations in temperament and willingness to climb were observed in the 3 species studied. *Peromyscus rowleyi* and *P. californicus* were very similar in behavior. The young mice squeaked vociferously in protest all the time they were on the plane and it was usually necessary to pinch their tails in order to get them to move at all upon the 20 and 40 degree slopes, but they generally climbed without stimulation at the 60 degree slope. Of course this artificial stimulation was not conducive to good results, but in this instance it was essential if any results at all were to be obtained. Following stimulation, paths were not recorded unless the mouse turned slowly upward and appeared to orient himself before creeping. Often when stimulated, the mice of these 2 species would curl up and roll to the bottom of the plane rather than climb. They climbed easily enough when forced to do so. Mice of the third species, *P. maniculatus*, represented by the semi-arboreal race *artemisiae* and the 3 non-arboreal subspecies *bairdii*, *osgoodi*, and *nebrascensis*, were much easier to handle than mice of the other two species, and with the exception of a few stubborn individuals (mostly *bairdii*), climbed willingly with few vocal protests. It is interesting to note that the temperament of the semi-arboreal mouse *P. maniculatus artemisiae* more closely resembles that of the non-arboreal races of the same species than the arboreal species *P. boylii* and *P. californicus*.

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BIG GAME ANIMALS IN THE NORTHEASTERN UNITED STATES

By George G. Goodwin

About the beginning of the nineteenth century there was a rapid decrease in the number of big game animals in the northeastern United States. Relatively speaking, these animals had disappeared by about 1850, except in the northern sections of the New England states. Although the general facts are well known, accurate information concerning their former distribution and abundance in the east is so scattered and difficult to obtain that any data always are of value. I am taking this opportunity to ask the readers of this article who have any information on this subject to be so kind as to communicate with me.

MOOSE AND CARIBOU

Moose and possibly caribou continued to exist in northern Vermont and New Hampshire until about 1900, and still on rare occasions they may stray into the upper parts of these states. There is an official report in the office of the State Game Commissioner of the killing of moose in Wenlock, Essex County, Vermont, in 1900. Mr. C. F. Jackson in a letter to E. T. Seton, dated December 12, 1921, wrote: "During the last three weeks, a young bull moose has been seen frequently in the town of New Ipswich, New Hampshire. A fairly good photograph was secured, and there can be no doubt of the record. This is the first record for the southern part of the state for several years."

Percy B. Falding, veteran guide in the Serpentine River and lake region of New Brunswick, saw more caribou in the winter of 1927–28 than previously he had seen for about 20 years. In Maine the present range of the moose and caribou extends south as far as Grafton. I do not have much recent information about the caribou in Maine, but an article in Forest and Stream (vol. 98, p. 608, 1928) states that in 1927 guides and camp owners in the Moosehead Lake district of northeastern Maine reported having seen increasing numbers of caribou during the 3 preceding years. In 1927 over a dozen fair sized herds of caribou were reported as seen in this district. The thing that most forcibly impressed the man who saw these animals was their excellent condition.

In the Allegash River section of northern Maine, also in the winter of 1927–28, more caribou were reported than at any time during the preceding 25 years. For many years prior to this time caribou were exceedingly scarce in this section, and it was not until 1924 that they began to return. These caribou seem to have been following the rivers from their sources. Particularly is this true of the St. John River. In 1927 a few caribou were seen on the upper reaches of this stream. By 1928 they had extended their range over almost two-thirds of the course of the river, or about 350 miles. It is likely that they will soon be found near its mouth, as the movement is surely southward by easy stages. Some of the caribou apparently have deviated from the paralleling river systems in favor of a more southerly course, and are heading into eastern Maine. From the accounts I possess it seems likely that caribou are increasing in numbers in the sparsely-inhabited sections of northern Maine, and the future bears a certain amount of assurance for the perpetuation of the animal in this state.

In the Adirondack region, moose were numerous in the early forties of the last century, but then were diminishing rapidly in numbers. It was only a few years later that the last moose was killed in this state, on the east inlet of Raquette Lake, during the month of August, 1861.

Rhoads omitted moose from his list of Recent Mammals of Pennsylvania, but Dr. Schoepf, the distinguished German traveler, mentioned the black moose as having

occurred in Northampton County in 1783; and moose were also reported to him as having been numerous in the Allegheny Mountains between what are now Altoona and Pittsburgh.

At the beginning of the eighteenth century, the range of moose extended south into New England at least as far as southern Massachusetts. Accounts of early travelers give no indication that the genus was ever found in Connecticut during historic times. William Wood, in his New England Prospect (1634), said that there were not many moose at Massachusetts Bay, but that 40 miles to the northeast there was a great store of them. This, according to Sherman Adams, was in the vicinity of Plymouth, Massachusetts, which is so close to the Connecticut border that it seems reasonable to assume that in early times moose inhabited parts of what is now the State of Connecticut.

WAPITI

Wapiti survived in New York until about 1836, but it is not known when the species was exterminated in this state. DeKay wrote, in 1842: "The stag is still found in the State of New York but very sparsely and will doubtless be extirpated before many years." These animals remained a little longer in the mountains of Pennsylvania than in New York. They were fairly numerous in the Allegheny Mountain system until the beginning of the nineteenth century. The last of them in the Blue Mountains were wiped out about 1800. An Indian, Jim Jacobs, killed a bull on the head waters of the Clarion River in 1867, but the last individual reported for the State of Pennsylvania appears to have been a young bull killed by John Decker in 1877.

Judging from what is known of the former general distribution of wapiti, this animal undoubtedly once inhabited parts of Massachusetts and Connecticut.

DEER

It is interesting to note that the white-tailed deer was nearly, if not entirely, exterminated in Connecticut about 1850. It seems reasonable to assume that the deer in neighboring states greatly diminished in numbers at that time.

BUFFALO

In northwestern New York buffalo were abundant in 1721 on the open meadows south of Lake Erie. The City of Buffalo perpetuates the tradition of the former existence of the genus in this region. History and known records, so far as I know, fail to tell us how long after this date the animal persisted in the state. We can assume, however, that it was plentiful until the middle of the eighteenth century. The forests of Pennsylvania contained thousands of buffalo as late as 1750; but 50 years later the animals were practically extirpated. The last Pennsylvania buffalo was killed in Somerset County by Joseph Shank in 1810. There is some evidence that before the coming of the white man the buffalo range extended east through the Connecticut River Valley to the coastal plains. The River Titicus in Connecticut formerly bore an Indian name which, according to tradition, signified Buffalo Creek. W. J. Hayes (American Naturalist, vol. 5, p. 389, 1871) stated that buffalo formerly ranged along the Atlantic coast from the Connecticut River Valley to Florida. Hudson, when he landed on the Island of Manhattan, found some of the Indians wearing buffalo robes, and shoes made from buffalo hides. These, however, may have been acquired by trade from inland tribes.

COUGAR

With the extirpation of the big game animals in the east, the large predators were forced to turn for subsistence to domestic stock. The large bounties offered for their destruction soon made them scarce and it was not long before they too disappeared.

The Adirondacks appear to have been the final stronghold of the cougar in the east. Several were reported to have been killed in New York about 1877. The last record for the state was in 1894, when Game Protector R. B. Nichols saw a cougar 7 miles above Indian Lake Corners on the Cedar River. In Pennsylvania bounties were paid for "panther" in 1866, and two were killed in Clearfield County in 1891. In New Jersey the last cougars were destroyed between 1830 and 1840. At one time they were not uncommon in southern Massachusetts and in Connecticut; but they disappeared in this region some time before 1800. Linsley, 1842, stated that he saw a specimen in Mix's Museum that was supposedly killed in northern Connecticut. A few remained in northern Vermont and New Hampshire until about 1888; two were reported in 1907 as having been seen 50 miles from Norcross, Maine, and one, according to accounts, was shot in that state about September 1, 1906. The last cougar reported killed in Vermont was shot by Alexander Crowell near Barnard, November 24, 1881. This was a large animal weighing 182 pounds and measuring 7 feet in length. The specimen now is in the state collection at Montpelier. It is reported that two men, while hunting in 1891 near Andover, Maine, saw and shot at a cougar.

WOLF

Wolves appear to have persisted in the east in fair numbers until towards the end of the nineteenth century. Between the years 1871 and 1882 bounties were paid in New York State for 45 wolf scalps. Reuben Cary killed a wolf at Brandreth Lake, Hamilton County, in November, 1893. This, apparently, was the last survivor of the Adirondack packs. The following three later records of wolves killed in New York are probably of stray animals from Canada: one at Stephentown, November 21, 1902; one at Port Byron, 11 miles north of Auburn, November 21, 1906; and one near Whiteface Mountain, Wilmington, about February, 1923. In Pennsylvania wolves were not uncommon in the eighties. Stragglers were killed or reported as seen prior to about 1898. In southern New England they disappeared about 1850. The last wolf in Connecticut was killed near Bridgeport in 1837; the last New Hampshire individual in the White Mountains in 1887. A wolf was shot by J. W. White at Norway, Maine, during the winter of 1908–09. This, according to accounts, was the third wolf killed in Oxford County within a few years. Recently I had the opportunity of examining some records of Butler County, dated from 1807 to 1845, but omitting the 10 years from 1815 to 1825. From 1807 to 1831 bounties were paid in this county on 235 wolves and one cougar. After this date these payments terminated abruptly, with the exception of one paid for a wolf killed in 1840. They continued to 1845, however, for large numbers of wild cats, and for red and gray foxes. The largest number of wolves brought in on one day was on May 20, 1825, when bounties were paid for 10, killed by John Pollock.

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THE EVOLUTION OF LOCOMOTION IN MAMMALS

By P. Magne de la Croix

For many years I have studied the locomotion of vertebrates, with a view to an understanding of the evolutionary steps that have led to the different sorts of progressive movements characteristic of various mammal types.

In unicellular animals of the spirochete type, progression is attained by screw-like contortions. Later in the evolutionary scale these movements usually become localized, along a lateral line in aquatic species, and are typically S-shaped in character, consisting of a double curve. Again in typical cases, it is believed that the character of these S-shaped movements has a direct bearing upon the appearance of 4 pseudopods, and that the latter in turn discourage the amplification of the body contortions. This appears to have initiated locomotion in vertebrates.

The cartilaginous fishes utilize S-shaped movements, and 4 appendages occur in the usual positions. The bony fishes, however, have altered the S-shaped character of progression and are losing the posterior appendages. Only the former thus appear to follow the type of locomotion characteristic of the protovertebrates.

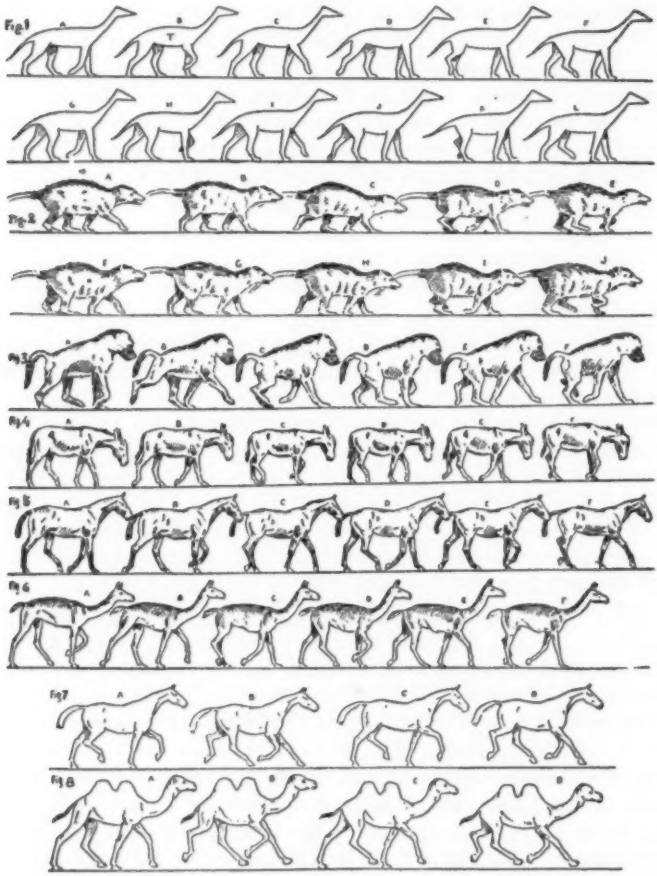
When vertebrates first adopted a terrestrial existence, there appears to have been two courses followed: (a) abandonment of the S-like movements and adoption of a pace in which the fore- and hind-limbs are diagonally opposed, adopted by the phylum which led to birds. The second (b) retained the S-shaped movements (abandoned only upon the attainment of true walking), but utilized lateral opposition of fore- and hind-limbs. The latter feature characterized the phylum that led to the Mammalia.

In both phyla locomotion is typically of the tractive and not the propulsive type, as long as the organism remains cold-blooded. Hence, the former mode of progression is reptilian in character. It is only in warm-blooded vertebrates that the propulsive type of locomotion is encountered.

At this point I wish to explain that I have followed the example of Raabe (1870) in considering that a step, in locomotion, should be divided into 6 periods, 3 of the sort illustrated by a normal pendulum (center being at the shoulder or hip joint), and 3 being illustrated by an inverted pendulum (center being where the foot contacts the ground). In the reptilian stage, pauses intervene, and each of these lasts as long as the corresponding periods of action. In consequence reptilian locomotion consists of a number of paces each of which comprises more than 6 periods. Each pace should, therefore, be divided into 6 active periods, and a variable—X—number of inactive ones, more numerous at a slow gait and limited to 4 in the metherpetic gait (transitional between the reptilian crawl and the true walk).

The first gait employed by the reptilian ancestor of mammals I have termed prototypic. In this a limb begins its locomotor cycle only after the one pre-

viously moved has again been placed upon the ground. In it there is alternation of either 3 or 4 feet always on the ground; and there are 6 active periods and 10 inactive ones. The gait may be observed in young puppies and kittens.

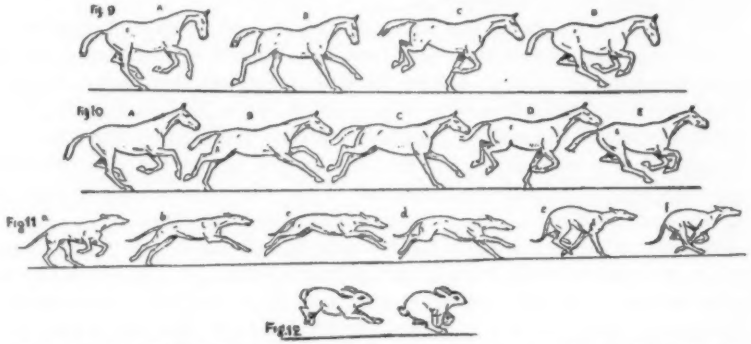


FIGS. 1 TO 8. Types of progression. Figure 1, mesherpetic pace; 2, opossum in metherpetic pace; 3, *Papio* in pithecoid walk; 4, old ass in walking trot; 5, mare in diagonal walk; 6, guanaco in lateral walk; 7, trotting horse; 8, ambling camel.

I have not illustrated it, for it is almost the same as the one that follows it, which I have termed mesherpetic, the only difference being the number of times that the 4 limbs experience complete stoppage. It is characterized by 6 active and 6 inactive periods. It is the gait of the chameleon.

The next gait in sequence is one that I have called metherpetic. In it the animal has begun to use propulsion, in addition to traction, initiating a diagonally bipedal base, in mixture with both tripedal and quadrupedal bases. It has only 4 pauses in each complete cycle. This is the gait of the opossum and is a warm-blooded development.

In the gait which I have termed the pithecoid walk the tractive type of locomotion and intermittent pauses both are abandoned, and the former replaced by the propulsive type. This is the first of the 5 types of walking gait, and is used by most of the primates. Like several other variations of the walk it has 6 active periods, and a characteristic is that the advance of the fore-limbs and the hind-limbs respectively comprises two periods.



FIGS. 9 TO 12. Types of progression. Figure 9, horse in three-times gallop; 10, horse in race-gallop, first form, with centripetal suspension; 11, greyhound in race-gallop, second form, with both centripetal and centrifugal suspensions; 12, rabbit in race-gallop, third form, with centrifugal suspension.

The latter increases to 3 periods in the case of the anthropoid apes. It is well illustrated also in the case of a very old ass (asses usually employ the gait mentioned next), as illustrated. It is also the gait used by the early ancestors of man (Magne de la Croix, 1932). It is termed the walking trot.

The gait in sequence with the latter I have called the diagonal walk. It is the normal slow gait of asses and horses. In this the limbs have 4 periods. Following is the lateral walk, in which the active periods return to 5 in number. It is used occasionally by horses and regularly by guanocos and camels, and progresses naturally to the walking amble, of 6 periods. This is the gait which in the horse is colloquially termed "pace," in which both limbs of the same side move in precise unison.

The amble is seldom used in walking but is generally used in jumping. The jumping trot and jumping amble are consequently the first gaits employed in leaping; the ass, horse, and dog employ the former, and camel, giraffe, and occasional horse, the latter.

After the trot comes the gallop, in 3 periods, with 2 different arrangements. In the first, called the diagonal gallop (fig. 9), the first period is accomplished by one hind-foot, the second by the other hind-foot, and the third by the diagonal fore-foot. It is the form encountered in most mammals. In the second, termed lateral gallop, the sequence is the same except that the third period is accomplished by the ipsilateral (not diagonal) fore-foot. In the three-times gallop is chiefly used the diagonal, and in the race gallop the lateral, succession. The horse and some other mammals employ the former. Figure 9D shows a horse in centripetal, and 11c a greyhound in centrifugal suspension. The rabbit, however, adopts only the latter type of suspension. Lastly, there is the ricochet of the kangaroo, in which the animal does not place the fore-feet upon the ground.

Some kinds of reptiles unable to accomplish the sort of walk characteristic of mammals, exaggerated the S-like torsions. Certain of them employed it alone, and lost their limbs. Others, because of the fact that they could not accomplish the mammalian type of propulsion by the hind-limbs, lifted the fore-limbs clear of the ground, resulting in a disturbance in equilibrium that brought about a bipedal pace. First they trotted as did the chlamidosaur and then walked as did *Struthiomimus* of the Cretaceous. Bipedalism in reptiles, once so frequent, is not encountered in existing sorts.

Some mammals have adapted their fore-limbs to flying (bats), while others, such as apes, have recurred to a certain primitive form of gallop, which I have called pithecoid. In this the last step is made by a fore-limb, this being the first form of gallop (*Cebus*), while that utilizing one fore-limb and a hind one at once is the second form (*Papio*). The anthropoid apes all reached the walking trot and then began to stand erect. Man reached the walking trot in vertical position and added to it the jumping trot.

The ancestors of the pinnipeds succeeded in using the group of paces progressing from the diagonal walk to the three-times gallop, and only afterwards did they adapt themselves to the aquatic medium. Sea-lions on the ground still use the diagonal walk and the three-times gallop.

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AGE VARIATION IN PEROMYSCUS MANICULATUS GRACILIS

By Lee R. Dice

In earlier studies (Dice, 1932, pp. 13–14; 1933a, p. 7) it has been shown that in two subspecies of deer-mice, *Peromyscus maniculatus bairdii* and *P. m. rufinus*, there is a considerable amount of growth of body and skeleton after the mice are one year old. Mice of these two subspecies averaging two years of age are larger in every measurement than those averaging one year of age. On the other hand, no appreciable difference in pelage color was found between one-year old and two-year old mice.

There now are available a few specimens of another subspecies, *Peromyscus maniculatus gracilis*, over two years of age, and it therefore can be determined whether or not growth in these mice continues during the second year of life and later.

The stock of *gracilis* was trapped in 1923 in virgin hardwood forest 5 miles south of Elmira, Otsego County, Michigan. Three males and 3 females became the parents of a small stock, and there was some inbreeding. The available number of specimens of the one-year age-class is only 6, and no attempt has been made to use these first-year specimens in comparisons of the body measurements, although they are used in the averages of the tint photometer readings. Of the two-year age-class 19 specimens are at hand from mice killed at an average age of 101 (83–124) weeks. I have combined the averages for the three-year and older age-classes. Of these there are available 30 specimens; 22 from mice killed when 3 years old, 7 from mice 4 years old, and 1 from a mouse 5 years old, the average ages of all being 169 (132–252) weeks.

This stock of mice was collected by an expedition supported by the Michigan Department of Conservation. The cost of rearing the animals was borne in part by the Museum of Zoology and in part by grants from the Faculty Research Fund of the University of Michigan. All of the body measurements have been taken by myself. The skeletons were measured by R. M. Bailey and the tint photometer readings were made by Sherman Hoslett. The statistical computations have been made by Margaret Liebe and myself.

BODY MEASUREMENTS

In every body measurement the mice of the three- to five-year age-class average larger than the mice of the two-year age-class, indicating growth in body size after the second year of life (see table 1). The difference in body length between these age classes is not significant, but in all the other body measurements the differences are statistically important. In tail length the difference between the age classes is 7.80 ±1.28 mm., a difference 6.1 times its probable error. The hind foot of the females averages 0.919 ±0.197 mm. longer, and of the males 0.5 ±0.189 mm. longer in the older class, differences which are respectively 4.7 and 2.7 times their probable errors. The ear averages 1.258 ±0.142 mm. longer in the mice of the older age class, a difference 8.9 times its probable error.

TABLE 1

Average dimensions in millimeters of Peromyscus maniculatus gracilis

Stock from Elmira, Michigan

AGE CLASS	NO.	BODY LENGTH	TAIL LENGTH	♀ FOOT LENGTH	♂ FOOT LENGTH	EAR LENGTH
3–5 years	30	90.40 ±0.38	95.80 ±0.83	20.927 ±0.150	20.900 ±0.140	19.337 ±0.100
2 years	19	89.32 ±0.80	88.00 ±0.97	20.008 ±0.127	20.400 ±0.127	18.079 ±0.101
Difference.....		1.08 ±0.89	7.80 ±1.28	0.919 ±0.197	0.500 ±0.189	1.258 ±0.142
AGE CLASS	NO.	FEMUR	MANDIBLE	SKULL LENGTH	CONDYLE-ZYGOMA	BULLAR WIDTH
3–5 years	27	16.356 ±0.084	16.311 ±0.074	25.255 ±0.098	17.911 ±0.070	10.788 ±0.42
2 years	18	16.419 ±0.062	16.011 ±0.059	24.423 ±0.075	17.317 ±0.055	10.567 ±0.050
Difference.....		−0.062 ±0.104	0.300 ±0.095	0.831 ±0.123	0.595 ±0.089	0.221 ±0.065

TABLE 2

Pelage color of Peromyscus maniculatus gracilis

Stock from Elmira, Michigan. Average tint photometer readings in per cent

DORSAL STRIPE	NO.	RED	YELLOW	GREEN	PEACOCK BLUE	BLUE-VIOLET
3–5 years	29	9.07 ±0.15	7.76 ±0.15	6.55 ±0.13	5.90 ±0.11	5.34 ±0.09
1–2 years	22	9.55 ±0.21	8.09 ±0.17	6.91 ±0.16	6.23 ±0.13	5.64 ±0.13
Difference.....		−0.48 ±0.26	−0.33 ±0.23	−0.36 ±0.21	−0.33 ±0.17	−0.30 ±0.16
SIDE						
3–5 years	29	16.55 ±0.29	13.72 ±0.25	10.76 ±0.13	9.31 ±0.13	8.21 ±0.13
1–2 years	22	16.91 ±0.18	14.18 ±0.15	10.95 ±0.13	9.55 ±0.10	8.59 ±0.12
Difference.....		−0.36 ±0.34	−0.46 ±0.29	−0.19 ±0.18	−0.24 ±0.16	−0.38 ±0.18

The measurements of the skull and mandible all average larger in the mice of the three- to five-year age-class than in those of the two-year class, but the length of femur is not significantly different in the two age-classes. The difference in length of mandible and in bullar width of skull are respectively 3.2 and 3.4 times their probable errors and therefore are possibly significant. The condylo-premaxillary length of the skull is greater by 0.831 ±.123 mm. in the mice of the older age-class, and the condylo-zygomatic distance is 0.595 ±0.089 mm. greater in the older mice. These differences are each 6.7 times their probable errors and indicate definite growth of the cranium after the second year of life.

PELAGE COLOR

No pronounced change in color seems to occur in the older mice of the genus *Peromyscus*. For *gracilis* there are only a few specimens available from mice aged one year when killed; but it has already been shown that in *bairdii* and in *rufinus*, two other subspecies of the same species, there is no important difference in coat color, either of the dorsal stripe or of the sides, between mice averaging one year and those averaging two years of age. Comparing the specimens of *gracilis* from mice 3 to 5 years of age with those from mice 1 to 2 years of age (table 2), there is shown to be no significant age difference in the tint photometer readings for the several colors. In every comparison the older mice have slightly the lower readings, but for no color is the difference in average readings more than 0.5 per cent, nor greater than 2.3 times its probable error.

Only 8 specimens are available from mice of the four-year and five-year class taken together. These oldest mice, when compared to the mice of the three-year class, show no significant difference in coat color either for the side or for the dorsal stripe. The tint photometer readings do not differ more than 2.2 times their probable errors in any color comparison, and the differences are not fully consistent in trend.

While the number of specimens of *gracilis* available is too few for positive conclusions there is a strong indication that in these mice, after the post-juvenal pelage and until at least 4 years of age, there is no important change in color correlated with age.

No specimens of *gracilis* of ages greater than 5 years are available for study, although some individuals were kept until they were over 7 years old before they died of old age. These older mice appeared lighter in color than younger animals (Dice, 1933b, p. 147).

A few individual mice, probably by reason of bad health, developed pelages that were poor and thin. In these animals the coat appears to be both more ragged and darker than in normally healthy mice. The dark appearance is due both to a shorter length of the colored tips of the hairs, and to the thinness of the coat, which allows the dark basal part of the hairs to show more prominently. These defective specimens have been discarded and are not included in the averages.

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NESTING HABITS OF THE FLYING SQUIRREL GLAUCOMYS SABRINUS

By Ian McTaggart Cowan

The nocturnal habits and secretive nature of the flying squirrels place them among those animals about whose life history but little is known. During several years field work in British Columbia, a combination of fortuitous circumstances has enabled me to study several races of flying squirrels in as many different habitats, and to accumulate the data presented here.

BREEDING

It has been suggested by Seton (Lives of Game Animals, vol. 4, p. 392, 1929) that the members of the species *Glaucomys sabrinus* produce two or even three litters of young in a single year, as has been stated of *Glaucomys volans* by Howell (Revision of the American flying squirrels, North American Fauna no. 44, p. 8, 1918). This may apply to the genus in the southern parts of its range but is certainly not so in British Columbia and Alberta. In these areas there is no evidence of more than a single litter per year. The date of birth of the young may vary with latitude and altitude, but is generally in late May or early June. On May 23, while collecting for the National Museum of Canada, at Newgate, British Columbia, latitude 49 degrees north, I examined a nest containing three very small flying squirrels with the eyes still closed and hairless, which were probably not more than three days old. Again, on June 8, 1932, at Ten-mile Lake, about 10 miles northeast of Quesnel, British Columbia, latitude 53 degrees north, the nest of another flying squirrel was examined. In this, as in the former, there were three young, two females and a male. At this date they were 160 mm. in length, but still were sightless. The limbs, tail, and dorsal surface of the body were covered with a coat of very fine, short fur; the back was grizzled grayish brown, while the tail, head, and legs were darker. The flying membranes and ventral surface of the body were naked. The tail was cylindrical with no indication of the flattened condition of the adult. When removed from the nest the young emitted a shrill, squeaking chirrup. They were capable of a certain amount of locomotion, and when placed in a strong light they made efforts to reach darker surroundings.

Additional information on the time of breeding and the number of young was obtained by T. T. and E. B. McCabe of Berkeley, California, and Indianpoint Lake, British Columbia. A female taken on April 7, 1929, at Indianpoint Lake, Latitude 53 degrees north, exhibited no signs of pregnancy. Another female taken on May 6, 1929, at the same place contained two embryos one-third way down the uterine horns. One of these embryos in alcohol measures as follows: Total length, 60 mm.; tail, 12 mm.; hind foot, 6 mm.

NESTS

Seton wrote that the building of outside nests by *G. sabrinus* has not been recorded. Howell (1918, p. 7) was of the opinion that the members of this species "occasionally construct outside nests, although, as is the case with *volans*, hollow trees usually are preferred." My observations would lead to somewhat different conclusions.

There are indeed two general types of nests constructed. First, nests in abandoned woodpecker holes and other cavities in trees: Second, outside, or dray type nests.

In regard to the first type, young undoubtedly are brought forth in nests of this sort,

but so far I have not encountered any such instances in the area under consideration. On several occasions, however, I have taken lone females or males from such nests. At Alta Lake, British Columbia, July 26, 1933, a large female *Glaucomys sabrinus fuliginosus* was taken at the base of a dead hemlock (*Tsuga heterophylla*). As this individual showed signs of having recently been with young the tree was felled in the hope of discovering her family. The tree was hollow from 6 feet above the ground for a distance of about 20 feet. This cavity was interrupted in two places by transverse partitions of wood that had not decayed sufficiently for removal by the squirrels. The rest of the hollow trunk contained approximately 6 cubic feet of nesting material.

The nest material was of the kind generally used by this race, and consisted of the finely shredded bark of giant cedar (*Thuja plicata*). The remains of 14 nests were readily discernible in this tree, and doubtless many more were represented in the consolidated mass at the bottom of each compartment. Besides two old wasp nests the only animal remains present were the dried feces of flying squirrel and some dipteran pupa cases. The top nest in the uppermost compartment was still in the process of construction. The outside was of cedar bark, but the inner lining was composed entirely of wool fluff picked up about the doorway of a nearby cabin. This nest was not sufficiently commodious for a family of fully grown squirrels. It is my opinion that the old female had but recently left her young, and that this was to have been her winter quarters. The well grown young were subsequently seen on several occasions in the same clump of hemlocks.

The breeding nest of *Glaucomys sabrinus alpinus* found at Ten-mile Lake, British Columbia, was of the dray type. It was built 5 feet from the ground in a clump of 3 small spruces (*Picea engelmanni*) about 9 feet tall, and was exposed to the morning sun for about 4 hours each day. The nest was 12 inches high and 10 inches in horizontal diameter, and was entirely encased in a mass composed of dead twigs of willow and aspen and some large strips of willow bark. This outer framework was somewhat thicker at the base, where it formed a platform on which the nest rested. Inside the layer of twigs was a layer of dry aspen and willow leaves, some fine willow bark and a little dry grass. The interior of the nest was composed of the inner bark of the willow shredded very fine and this made a soft bed for the 3 young. The nest had two entrances, one at the top and one on the sheltered side next the trunk of the tree. The 3 spruces were on the edge of about 5 acres of second growth Canadian Zone forest. The dominant conifer in this isolated timber patch was the Engelmann spruce (*Picea engelmanni*). Other trees present in fair numbers were aspen (*Populus tremuloides*), birch (*Betula fontinalis*), Douglas fir (*Pseudotsuga taxifolia*), and willows (*Salix* spp.). The original forest of Douglas fir and spruce previously had been destroyed by fire.

A thorough search of this five-acre tract led to the discovery of the nest belonging to the mate of the female taken with the young, and also of some 15 old nests. The nest occupied by the male was about 15 yards from that of the female, and was placed close against the trunk of a small spruce, 15 feet from the ground. The base of this nest was a thin, bowl-shaped platform of sticks. On top of this had been piled a mass, 7 inches in diameter, of shredded willow bark, making a nest much smaller and more loosely constructed than that of the female with young. The other nests were of various ages. They were situated from 5 to 30 feet above the ground, in spruce trees with one exception. All but one were close to the trunks, and that was far out on the limb of a Douglas fir. One had evidently been built on an abandoned crow's nest; the rest were entirely the work of the squirrels. The nests varied in size and structure but could be divided into two general groups, large ones completely encased in twigs and bark, and smaller ones built on platforms of sticks.

Most of the nests were being used as feeding stations, as shown by their somewhat

flattened condition, together with the deposits of feces and remnants of spruce and fir cones upon them. Nests so used were indistinguishable from those of crows or jays when seen from below.

Sixty-three trap nights failed to produce any more specimens in this area, although there was used a wide variety of baits generally attractive to flying squirrels. Intensive search of the area at night failed to disclose any but the one pair of animals in this piece of woodland. In this instance the building of outside nests was entirely voluntary, as there were large numbers of old stumps bearing suitable nesting cavities; and indeed, some of these showed signs of recent occupancy. Although these possible nesting sites were examined on 4 consecutive days, no flying squirrels were found in any stump in the area examined, which extended for a half-mile in all directions.

The heavy precipitation of the winter months might render these exposed outside nests uninhabitable during that season. It is very probable, therefore, that the stump cavities served as winter quarters. Similar outside nests were found during June, 1930, in Jasper Park, Alberta, when a lone flying squirrel was found inhabiting a nest similar to the one described as the nest of the male. This animal was not secured.

In the heavy spruce forests of the lower mountain slopes west of Newgate, British Columbia, a breeding nest was found on May 23, 1930, containing an adult female and 3 newly born young. This was built entirely of old man's beard lichen (*Usnea barbata*). An axe notch in the base of a spruce tree, about 3 feet from the ground, had been filled with the lichen and the nest cavity was hollowed out in the center of this mass of lichen. In the vicinity were several stumps bearing woodpecker holes, from one of which a male flying squirrel was taken. The stomach of the female occupying the nest contained nothing but *Usnea*.

In conclusion, it seems that while hollow trees are extensively used by flying squirrels for winter dwellings, certainly in the Transition Zone and in the drier parts of the Canadian Zone of south and central British Columbia, the outside, or dray, type of nest is preferred during the summer. These summer nests are of two types; large nests entirely surrounded by twigs, bark, and roots, and smaller nests consisting of a loose mass of nesting material built on a platform of sticks and bark. Nests of the first type are built by the female for herself and her brood. The second is the type usually occupied by the male, and perhaps also by the unmated female. The male, while occupying a separate nest from the female with young, nevertheless has his nest close to that of the female. The two animals are to be found feeding and playing together each night.

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GENERAL NOTES

MAMMAL REMAINS FROM AN ALEUT STONE AGE VILLAGE

While engaged in a botanical survey of the Aleutian Islands during the spring and summer of 1932, the author and his colleague, Dr. Eric Hulten, of the botanical museum of Lund, Sweden, found a number of old stone-age village sites on some of the islands.

Evidences of a former culture were noted on the Alaska peninsula, Unimak, Amaknak, Unalaska, Kagamil, Amlia and Atka islands. Nearly every large island has had a numerous population in former times. There are large and extensive ancient village sites on Kagamil Island which probably have never been investigated by an archaeologist. None of these islands is now inhabited.

The site of a stone age village in the Aleutians can generally be recognized during spring and summer by the predominance of two perennial plants. The more conspicuous is *Heracleum lanatum*, the wild rhubard or putschka of the Russians. The other is the deadly poisonous monkshood, *Aconitum kamtschaticum*, the powdered tubers of which were formerly used to poison arrows, for which purpose it still is used by the Ainus of northern Japan. The Kamchadals also did the same in the early days of Russian occupation.

Ten days during the month of May, 1932, were spent at digging in a stone age village on Amaknak Island, about one-quarter mile from Dutch Harbor. The exact spot is between the spruce grove and the sea. About 200 artifacts and implements of various kinds were collected, all made of bone and stone except one specimen, a kind of awl, apparently of ivory. The workmanship on most of the artifacts was crude and very simple, with almost no attempt at decoration.

Following is a list of mammal remains found in the kitchen middens:

Homo sapiens Linnaeus.—Several jaw bones, crania, and long bones were scattered on the refuse heaps. Jaws of ancient Aleuts are much more massive and primitive than those of the present day Aleuts. The teeth were in a remarkably good state of preservation. There is a strong suspicion that cannibalism was practiced to some extent. Evidently most food was eaten uncooked, for there is little evidence of charred wood, shell or bone ash in the layers of refuse.

Eumetopias jubata (Schreber).—Steller's sealion. Skulls, teeth and bones were common.

Phoca richardii pribilofensis Allen.—Northwest harbor seal. Remains of this common seal were scattered profusely throughout the diggings.

Balaenoptera physalus (Linnaeus).—Finback whale. On the floor of the village club house were a couple of jaw bones and several vertebrae that probably served as seats. This was the only true whale that could be positively identified.

Megaptera versabilis Cope.—Pacific humpback whale. In evidence of the occurrence of remains of this whale in the diggings were a few barnacles, *Coronula diadema*, an endemic cetacean parasite.

Phocaena phocoena (Linnaeus).—Harbor porpoise. Several broken skulls and ear bones of this species were collected.

No remains of any kind of land mammal were found. The Nushagak ground squirrel, **Citellus plesius ablusus** Osgood, was introduced from the mainland in recent times for fox food and is now extremely common on the islands as far west as Umnak Island.—WALTER J. EYERDAM, *9253 Corliss Avenue, Seattle, Washington.*

MAMMALS COLLECTED IN NORTHERN MANITOBA

Doctor R. G. Green, bacteriologist of the University of Minnesota Medical School, and the writer spent the month of August, 1933, in northern Manitoba engaged in re-

search work on the diseases of wild life. The writer, in addition to assisting Dr. Green, made collections for the Museum of Natural History, University of Minnesota.

The following annotated list comprises mammals collected in the vicinity of Cormorant Lake, Mile 42 from The Pas, on the Churchill Railroad. Collections were made over two periods; from August 1 to 12, and August 30 to September 2, 1933.

Sorex cinereus cinereus Kerr; 3 adults.

Mustela cicognani cicognani Bonaparte; 1 skull from a trapper's cabin.

Eutamias minimus borealis (Allen); 2 adults.

Sciurus hudsonicus hudsonicus (Erxleben); 2 adults.

Castor canadensis canadensis Kuhl; 1 skull from a trapper's camp.

Peromyscus maniculatus borealis (Mearns); 3 adults and 3 juveniles.

Synaptomys borealis (Richardson); 1 adult.

Clethrionomys gapperi gapperi (Vigors); 10, including 1 in the extremely gray phase.

Microtus pennsylvanicus drummondi (Audubon and Bachman); 2 adults and 3 juveniles.

Ondatra zibethica alba (Sabine); 4 skulls taken at trapper's cabin.

Lepus americanus americanus Erxleben; 1 adult and 3 juveniles.

At Churchill only 3 species were collected, between August 14 and 28, 1933.

Dicrostonyx rubricatus richardsoni (Merriam); 4 adults and 5 juveniles.

Microtus pennsylvanicus drummondi (Audubon and Bachman); 1 adult and 3 juveniles.

Lepus americanus americanus Erxleben; 1 juvenile.

August 25 and 26 were spent at Nonala, on the bay 80 miles north of Churchill, where were found 3 other species as follows:

Alopex lagopus innuitus (Merriam); 1 complete skeleton, trapped the previous winter near the post.

Microtus pennsylvanicus aphorodemus Preble; 2 adults and 2 juveniles.

Clethrionomys dawsoni dawsoni (Merriam); 1 adult.

With the exception of the Arctic fox skeleton, this material all has been checked and identified by H. H. T. Jackson, U. S. Biological Survey.—W. J. Breckenridge, *Museum of Natural History, University of Minnesota, Minneapolis, Minnesota.*

THE TYPE SPECIMEN OF ERINACEUS ALBIVENTRIS WAGNER

In his supplement to Schreber's Säugethiere (vol. 2, 1841), Wagner described as new, two hedgehogs, *Erinaceus albiventris* (p. 22) and *E. pruneri* (p. 23). The former was based on a single specimen, obtained from a dealer, Brandt, who had received it with a shipment of Indian animals. The brief description contains little that is especially diagnostic, while even the place of origin was not known with certainty, for Wagner stated: "Die Heimath kann ich nicht genau bestimmen." The description of *E. pruneri* on the page following was drawn from hedgehogs sent by Dr. Pruner from Cairo; these came doubtless from the Upper Nile region where he travelled and collected. In later years it has come to be generally accepted that these two names really apply to one and the same animal, and since *E. albiventris* has page precedence, it has been retained for the four-toed hedgehogs of northeastern Africa. This species, moreover, later was made the type of the genus *Atelerix* of Pomel (1848), a group which Thomas (Ann. Mag. Nat. Hist., ser. 9, vol. 1, p. 193–196) formally recognized in 1918. In 1922, the late J. A. Allen (Bull. Amer. Mus. Nat. Hist., vol. 47, p. 8) reviewed at length the rival claims for recognition of the two names *albiventris* and *pruneri*, pointing out that the subsequent assignment of the former to the Sudan had no basis in fact, and concluding that, because of the meager description and the lack of a type locality, it should be placed "permanently in the list of unidentifiable species," leaving *pruneri* as the specific name of the four-toed hedgehog of northeastern Africa.

The type specimen of *Erinaceus albiventris* is still preserved in the Zoologische Sammlung des Bayerischen Staates at Munich. There Dr. John Anderson must have examined it, as suggested by J. A. Allen, for the former wrote in his Mammals of Egypt (p. 164, 1902): "The specimen upon which Wagner founded this species, came, in all probability, from Senegambia." The basis for this statement, however, did not then appear. Recently, through the kindness of Prof. Dr. W. Leisewitz of the Munich Museum, I have had the opportunity of examining this specimen. It had been mounted, but later was taken off its stand and the supporting wires in the legs cut off close to the feet. The skull has been carefully removed and cleaned but lacks the basal part from palate to occiput. The skin is in excellent condition and agrees completely with the description and figures of *Erinaceus adansoni* Rochebrune (1883), from Senegal. This fact, doubtless, did not escape the keen eyes of Dr. Anderson, and probably led him to assign Senegambia as its place of origin, for it might readily have been brought from there by some vessel returning from India via the Cape of Good Hope. Anderson, however, was content to regard the eastern animal as a subspecies of the Senegambian hedgehog, calling it *Erinaceus albiventris pruneri*. But it now appears from an examination of the type of *albiventris* and a near-topotype of *pruneri*, that the two are really quite distinct species, although doubtless closely allied. As originally described by Wagner, the spines of *albiventris* are very pale, with whitish tips and bases, and with pale ochraceous intermediate band, whereas in *pruneri* and its races, the bases of the spines are of a brownish or dark-drab tint which deepens to smoke color or blackish brown on the middle portion of the spine, then rather abruptly pales out to white in the terminal fourth, with a minute dark point, easily visible with a lens. In *albiventris* the hair of the legs and under parts, and of the head, is everywhere grayish white, without a sign of the blackish mask that covers the snout and lips in the *pruneri* group. A striking difference occurs in the distribution of the hair on the head, for whereas in the latter and its allies, the lips and the rostrum from the rhinarium back to the level of the eyes are thickly clothed with short blackish hairs, and even the skin of these parts is dark blackish, in *albiventris* the longer hair of the forehead extends forward in a narrow median line from the level of the eyes halfway to the tip of the nose. Thence this continues ventrally by a narrow strip of minute gray hairs extending to the region of the mustachial vibrissae, thus cutting off on each side in front of the eye a wholly naked, rounded area. In the skull the last incisor, the upper canine, and the anterior premolar are two-rooted, and the type is perhaps peculiar in lacking completely the small second premolar, not even an alveolus for which is present, although as Wagner mentions, a small diastema indicates its place. In other respects the skull and teeth are not greatly different from those of *pruneri*.

It is clear from Rochebrune's description and figure that his *Erinaceus adansoni* from Senegambia is quite the same animal, so that this name becomes a synonym of *albiventris*. His description of the coloration of the spines, and of the elongate, partly naked muzzle, applies perfectly to the type of the latter. These characteristics are probably the accompaniment of life under desert conditions, which tends to lighten the color, while the elongate snout may be an aid for burrowing in sand, for Rochebrune stated that the species occurs in the sand dunes between the Senegal River and the coast of Senegambia. The small size is also probably a distinguishing point. The type specimen as mounted is about 145 mm. long. The skull appears to be that of a fully adult animal, with well-developed supraorbital ridges and somewhat worn teeth. It presents the following measurements: Upper tooth row, 21.3; length of nasals, 14.7; lachrymal width, 12.5; interorbital width, 10.4 mm.

It follows, then, that *Atelerix pruneri* (Wagner) is the name of the black-faced, four-toed hedgehog of the Sudan, and *Atelerix albiventris* (Wagner), with its synonym *Erinaceus adansoni* Rochebrune, stands as a distinct species, from the sand dunes of the coast

of Senegambia.—GLOVER M. ALLEN, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

MELANISTIC PIPISTRELLES

Three cases of melanism in bats of the species *Pipistrellus subflavus subflavus* have been noted from one locality. The first, in the collection of G. L. Kirk, was taken November 22, 1914; a second, November 26, 1932; and a third, February 3, 1934. The three color bands of the pelage are distinct but not as striking as in normal individuals. While melanism is not rare it is probable that some individuals or pairs have a greater tendency towards the production of melanistic offspring than have others.—F. L. OSGOOD, *Rutland, Vermont.*

EARTHWORMS AS A SUPPLEMENTARY FOOD OF WEASELS

On June 3, 1933, while setting traps with G. H. Ross, we were forced by rain into a barn near the center of a large meadow. It was soon found that the barn was occupied by a pair of weasels, *Mustela cicognani cicognani*, and their young.

The animals were under observation from 2.15 until 5.00 p.m. Except for a short time at the beginning of this period the male did not appear. The female, however, made frequent and sometimes lengthy trips for food. A careful watch was maintained during the entire period to secure a complete record of the food brought to the young. During this time the only item brought to the young was earthworms. Some trips apparently were fruitless.

Well-beaten runways radiated from the barn. A careful check by means of mouse traps indicated that mice probably were entirely eliminated for some distance from the nest. An adjacent swamp yielded one bullfrog from 50 traps.—F. L. OSGOOD, *Rutland, Vermont.*

NOTES ON FOOD HABITS OF SOUTHERN WISCONSIN HOUSE CATS

The following data are from examinations of house-cat stomachs collected largely in Dane, Sauk, and Columbia counties, Wisconsin, incidental to ecological studies of the bob-white carried on at the State University (1929–32).

Data from 50 stomachs taken from October 15, 1929, to January 1932:

Individuals of prey: Cottontail (*Sylvilagus*), 3; Norway rat (*Rattus*), 7; meadowmouse (*Microtus*), 26; deermouse (*Peromyscus*), 8; housemouse (*Mus*), 3; unidentified mice, 9; short-tailed shrew (*Blarina*), 1; English sparrow (*Passer domesticus*), 2; domestic chicken (*Gallus*) (two feet and one head, probably carrion), 3; domestic pigeon (*Columba*), 1; unidentified small birds, 3. Stomach contents high in grasshoppers (*Melanoplus*), 3; crickets (*Gryllus*), 1; June beetles (*Phyllophaga*), 1. Miscellaneous substances: cooked meat in 3 stomachs; fatty offal in 1; cheesy material, 1; milk, 3; potatoes, 7; ensilage, 2; string beans, 1; custard pudding, 1; cooked rice, 1; apple, 1; green foods such as grass or clover, several; mass of heavy cord, 1; cloth, 1.

Of the 50 cats, 7 evidently were pets, 39 appeared to be self-sufficient hunters or scavengers, 2 were positively feral (both February-killed males, of which one stomach contained 3 meadowmice and the other, cottontail, 2 deermice and the foot of a domestic chicken) and 2 others were suspected feral.

I am not inclined to regard the data on these cats as presenting a really true cross-section of food habits. For one thing, the cats which, by their actions, were hunting—those along roadsides, in stubble and hayfields—were readily seen and collected, or picked up dead on the highways, whereas chances seldom presented themselves to take the elusive woods-dwellers which are most likely to be feral, and also to have the best access to avian prey.

Prey forms taken, according to the data, are of small to medium size and of rather uniformly slow-moving types, with occasional individuals of more active species proving vulnerable to feline stealth and patience.

Although H. L. Stoddard (The bob-white quail, *Scribners*, 1931) found that the house-cat preys heavily upon incubating Georgia bob-whites and their chicks, and my own bob-white studies have indicated that this may occur in the north-central states, I find scant evidence of adult, strong, winter birds suffering cat predation to any extent. Personal notes from field observations show but 3 adult quail killed by cats, and one was a bird with an unhealed, disjointed wing. A farmer told me of several quail having been killed by a cat in his corn crib, but there the birds were manifestly taken at an unusual disadvantage; indeed, I suspect that many or most of the normal adult quail caught by cats (aside from adults incubating or defending young) are birds fortuitously cornered in some way or other.

Then again, recent studies on adult northern bob-white populations point to a very close correlation between the severity of winter predation and the numerical position of the quail population in relation to the capacity of the land to accommodate it. Well accommodated populations lost at a low rate; material depredations in other instances represented largely the removal of an ill-situated surplus or that part of the population in excess of environmental carrying capacity. (For data and discussions, see Errington, Paul L., Bobwhite winter survival in an area heavily populated with grey foxes. Iowa State College Jour. Sci., vol. 8, pp. 127–130, 1933; and Vulnerability of bob-white populations to predation. Ecology, vol. 15, pp. 110–127, 1934).

From the above thesis there is apparent the probability that any study of the house-cat intended thoroughly to divulge its ecological status would have to answer not only the question of what the cat eats, but the actual effect its preying may have upon the species in question. Preying upon a species is not necessarily synonymous with controlling it or even influencing its numbers to any perceptible degree. Predation which merely removes an exposed prey surplus that is naturally doomed anyway is entirely different from predation the weight of which is instrumental in forcing down prey populations or in holding them at given approximate levels.—PAUL L. ERRINGTON, *Iowa State College, Ames, Iowa.*

STOMACH CONTENTS OF ATLANTIC HARBOR SEALS

During the summer of 1934 I had an opportunity to collect the stomachs of 9 adult Atlantic harbor seals, *Phoca vitulina concolor*, which had been killed by bounty hunters in Barnstable Harbor, Cape Cod, Massachusetts. Four of these were taken in May and 5 in August. Five stomachs were empty or contained only parasitic worms. The following notes on the contents of the other 4 stomachs appear to be of interest. The skeletal remains in numbers 8 and 9 were identified by Dr. N. A. Borodin of the Museum of Comparative Zoology, and I wish to express my appreciation of his kindness.

No. 2, taken May 24, 1934. Several pieces of the vertebral column of one or two small, unidentified fish.

No. 3, taken May 24, 1934. Five or 6 fragments of small vertebral columns, apparently of the same species of fish as present in no. 2.

No. 8, taken August 27, 1934. Contents about 2 quarts. Partially digested fish remains, to the number of 19 whole and fragmentary vertebral columns 8 to 12 inches long. Eight of these were menhaden (*Pomolobus* sp.) and 11 were alewives (*Brevoortia tyrannus*).

No. 9, taken August 27, 1934. Contents about one and one-half quarts. Vertebral columns of at least 2 menhaden and 11 alewives could be separated.

The state of Massachusetts pays a bounty of 5 dollars each for harbor seals, in spite of the fact that little is known of their economic status. Certainly the stomach exami-

nations by Scheffer and Sperry (Jour. Mamm., vol. 12, 1931; vol. 9, 1928) indicated that the Pacific harbor seals, at least, do no great harm.—DONALD R. GRIFFIN, *Barnstable, Mass.*

NAPAEOZAPUS IN HARVARD FOREST

During the summer of 1934, it was the privilege of the writer, as a member of the research committee of the Forbush Bird Club, to visit Harvard Forest, Petersham, Massachusetts. A short trap line was run July 13 and 14, and upon the latter date a nursing female of the woodland jumping mouse, *Napaeozapus insignis insignis* (Miller) was secured just south of Moccasin Brook. It had 4 mammae. The terrain is covered with white pine and hemlock.

The above-mentioned species is not included in the published list of the mammals of Harvard Forest (Hatt, R. T. The relation of mammals to the Harvard Forest. Roosevelt Wild Life Bull., vol. 5, pp. 636–645, 1930), and the authorities at the Harvard School of Forestry are unable to find any previous record for the forest.

Thanks are due Mr. A. C. Cline, acting Director of the Harvard Forest, for permission to work there, and to Mr. N. W. Hosley and Dr. G. M. Allen for their coöperation in checking the records. The latter also verified the identification of the specimen. The skin and skull are in the personal collection of the author.—HARRY C. PARKER, *Worcester Museum of Natural History, Worcester, Massachusetts.*

AN UNUSUAL BEAVER HABITAT

While one may expect to find beaver inhabiting mountain streams and lakes where cottonwood, aspen and willow are common, it is somewhat unusual to discover these animals living in such a rapid and muddy stream as the Colorado River in Grand Canyon National Park.

For several weeks during the months of April and May, signs of beaver were seen near the Kaibab Suspension Bridge over the Colorado River. Several days after sign was first noted a group of C.C.C. men saw the animal. An examination of the region indicated that the beaver was utilizing salt cedar (*Tamarix gallica*) and arrow-weed (*Berthelotia sericea*) as sources of food. No trace of his hiding-place was to be found. The rocky nature of the river banks in this area renders it likely that the animal did not dig a den, but instead utilized some shelter among the rocks.

It is a known and accepted fact that beaver utilize the Colorado River in moving from one tributary stream to another, but records fail to reveal any account of the animal actually living along this part of the river for any appreciable length of time.—RUSSELL K. GRATER, *National Park Service, Grand Canyon National Park, Arizona.*

FURTHER NOTES ON THE GIANT BEAVER

Since the publication of my paper on the distribution of the fossil beaver *Castoroides ohioensis* (Cahn, Jour. Mamm., vol. 13, pp. 229–241, 1932), several new records, and some other information, have come to hand. In the following notes the numbering of the records coincides with or follows that of my previous paper.

OHIO

No. 2. Wilmington specimen, Clinton county. This skull, mentioned in the previous paper, is in the Ohio State Museum, Columbus, Ohio, according to a letter from Dr. H. C. Shetrone. It is not, however, the property of the Museum.

INDIANA

No. 15. St. Joseph specimen, St. Joseph County. Lower left incisor. Now in the Northern Indiana Historical Society Museum, South Bend, Indiana. Age: Wisconsin. Reference: Engels, Amer. Midland Nat., vol. 12, p. 529, 1931.

ILLINOIS

No. 8. New Bedford specimen, Bureau County. Left upper incisor, complete and unbroken; right ramus of the lower jaw complete, with the incisor broken at the edge of the socket and all other teeth missing; right humerus complete. The specimens are deposited in the Natural History Museum, University of Illinois. Age: Wisconsin; not mentioned in literature.

No. 9. Rockford specimen, Winnebago County. Right ramus of the lower jaw; left lower incisor complete; left humerus complete. Found in a swamp east of Rockford, from which considerable Pleistocene material is being recovered. Now in the Natural History Museum, University of Illinois. Age: Wisconsin; not mentioned in literature.

No. 10. Aurora specimen, Kane County. Right femur; reported as having been taken from peat layer, but author considers it probable that it came from the marl layer. Now in the museum in Phillip's Park, Aurora, Illinois. Age: Middle Wisconsin. Reference: Smith, Science, n.s., vol. 81, p. 380, 1935.

GEORGIA

No. 3. Second Savannah River specimen, Chatham County. Fragments of several incisor teeth; probably parts of 3 teeth are represented. Dredged from the Savannah River near Savannah, Georgia, by Mr. Ivan Tomkins. Now in the Reading Public Museum, Reading, Pennsylvania. Not mentioned in literature.

MICHIGAN

No. 7. Niles specimen, Berrien County. Found 2 miles northeast of the city of Niles. A well preserved skull; both zygomatic arches and facial portions of the maxillae missing; dental series in good condition and complete. Now in the museum of the Northern Indiana Historical Society, South Bend, Indiana (No. 1195). Age: Post-Wisconsin. Reference: Engels, Amer. Midland Nat., vol. 12, p. 529, 1931.

The Detroit News for November 12, 1932, carried an account of the finding at Wyandotte, Michigan, of a piece of petrified wood, the "handiwork of a pre-pleistocene beaver, that had felled the tree. Marks of the teeth of the beaver can plainly be seen on the wood. The marks are of a tooth larger around than one's finger." Through the courtesy of Mr. C. M. Nacker of Detroit, the specimen was shipped to me for study. For the benefit of future records it should be said that this is not petrified wood, but is a fibrous iron, mineral rock, and that the grooves referred to are not the work of the Pleistocene beaver.

ARKANSAS

No. 1. Jonesboro specimen, Craighead County. A badly fragmented skull found in 1932, which, when reconstructed, yielded as follows: Both premaxillae and maxillae; jugal and zygomatic processes of the squamosal on the right side; the complete roots of both upper incisors; fragments of 3 teeth; first left premolar entire. Now the property of the Natural History Museum, University of Illinois. Not mentioned in literature.

—ALVIN R. CAHN, *Zoological Laboratory, University of Illinois, Champaign, Illinois.*

SIZE AND WEIGHT OF ADIRONDACK DEER

Many Adirondack guides and hunters believe that individuals of the white-tailed deer, *Odocoileus virginianus borealis*, taken in recent years are not as large as those of

earlier days. Accurate weights and measurements recorded by observers over a long period may aid in a better understanding of this subject.

Seton (Lives of game animals, vol. 3, pp. 232–233, 1927), gives the live weights of the following large male deer from New York State: 375 pounds, Franklin County, 1877; 400 pounds, Warren County, about 1896; and 400 pounds, Saratoga County, 1890.

The live weights of the largest bucks of which I have records are as follows: 326 pounds, Ulster County, 1927; 355 pounds, Ulster County, 1928; and 386 pounds, Franklin County, 1932. A buck that I weighed at a slaughterhouse in Rensselaer in 1932 was 312 pounds dressed and 390 pounds live weight. I did not learn the locality in which this specimen was killed. The largest deer that I recorded weighed 318 pounds dressed or 397 pounds entire. It was taken in Greene County, 1933.

The following summary of the sizes and weights of deer is arranged with regard to age and sex.

Live Weight.—Adult male: "Spike horns", with spikes not less than 3 inches long, usually weigh 125 to 150 pounds. The smallest I have recorded is 113 pounds and the largest 160 pounds. Prong horns, or 4 point bucks, usually weigh 160 to 170 pounds, although I weighed one which was only 125 pounds. Larger bucks have weighed as follows: 6 point, 180 pounds; 8 point, 187, 205 pounds; 9 point, 185 pounds; 10 point, 175, 386, 397 pounds; 12 point, 250, 326 pounds; 14 point, 279 pounds; 15 point, 390 pounds; 16 point, 355 pounds.

Adult female: Usual weight from 130 to 160 pounds. The smallest I have weighed was 125 pounds and the largest 165 pounds. The average of 8 individuals was 145 pounds.

Young at the age of about 6 months weigh 95 to 106 pounds.

Size.—Adult male: Total length, 61 to 76 inches; tail, 9 to 12 inches; hind foot, 19 to 21 inches; ear, 7 to 8 inches; height at shoulder, 33 to 41 inches; depth of chest, 14 to 18 inches.

Adult female: Total length, 60 to 69 inches; tail, 9 to 11 inches; hind foot, 18 to 19 inches; ear, 7 to 8 inches; height at shoulder, 33 to 39 inches; depth of chest, 14 to 18 inches.

Young about 6 months old: Total length, 57 to 60 inches; tail, 10 inches; hind foot, 17 to 19 inches; ear, 6 to 7 inches; height at shoulder, 27 to 34 inches; depth of chest, 12 to 13 inches.

After surveying the available material, I believe that the white-tailed deer of New York are as large now as they were in earlier days and that the following reasons may account for the contrary belief: Guides and hunters usually remember the exceptionally large deer and base conclusions on their recollections. The smaller and less impressive deer are not remembered for long. The number of hunters has increased steadily and the annual kill probably is greater than in earlier days. It is possible therefore, that many deer which might attain a record size are killed before they are fully grown. Small, young deer are more numerous in the fall and more easily killed than wary old bucks. The proportion of small deer then killed would be very much greater than the proportion of large deer.—W. J. SCHOONMAKER, *New York State Museum, Albany, New York.*

RECENT LITERATURE

Taylor, Walter P. ECOLOGY AND LIFE HISTORY OF THE PORCUPINE (ERETHIZON EPIXANTHUM) AS RELATED TO THE FORESTS OF ARIZONA AND THE SOUTH-WESTERN UNITED STATES. Biological Science Bulletin no. 3, University of Arizona Bulletin, vol. 6, no. 5, July 1, 1935, 177 pp., 9 pls., 18 figs.

During recent years the porcupine has received considerable attention. Because it damages trees it has been argued in some quarters that the animal should be severely controlled, an opinion which has been translated into vigorous action. On the opposite side of the argument have been those who counselled moderation, cited the fact that damage by porcupines is negligible when compared to the disastrous results of overgrazing, and plead for delay until the economic status of the animals could be more accurately established.

In the confusion of recent years, precise, deliberate studies on the economic position of various vertebrates have appeared all too infrequently, in spite of accelerated need, and the report under consideration is doubly welcome, both in filling a real want, and as a possible harbinger of similar reports to come.

The present bulletin is a fair sample of Doctor Taylor's painstaking methods of investigation. The characteristics and habits of the animal are discussed at length, and, without being carpingly critical, we can discern no omissions except that the harmlessness of porcupines in forests so far from transportation that the timber can not be utilized, and their recreational value, might more strongly be stressed. Control methods are mentioned with some restraint.

In conclusion the author states that serious porcupine work was found chiefly on ponderosa pine in limited localities in five national forests; that the porcupine problem is largely man-made, as the effect of such actions as the removal of local predators; and that he has been impressed with the possibility that scientifically coördinated forest management will make unnecessary drastic porcupine-killing campaigns.—A. B. H.

Huey, Edward G. A CHILD'S STORY OF THE ANIMAL WORLD. 355 pp., illustrated. Reynal and Hitchcock, New York, November, 1935. $3.50.

Few readers of the JOURNAL OF MAMMALOGY, perhaps, have a great deal of personal interest in books for children; but readers have children of their own, and some concern in seeing that the youngsters' training is along sound natural history lines. This book fills a need of this sort. Mr. Huey has had much experience in the teaching of children and in writing for them. The style is simple and suited to its purpose, but a surprising lot of real information is presented. Best of all there is no catering to the spectacular. The statements are conservative and uniformly accurate. One third of the large and well-printed volume is devoted to invertebrates, and almost one-half of it to mammals in general.—A. B. H.

Enders, Robert K. MAMMALIAN LIFE HISTORIES FROM BARRO COLORADO ISLAND, PANAMA. Bulletin of the Museum of Comparative Zoology at Harvard College, vol. 78, no. 4, October, 1935, pp. 383–502, 5 plates.

In many, if not most, regions much more is known regarding the taxonomy of the mammalian populations than concerning their habits. This is particularly true of the areas of vast tropical forests. It is rarely, indeed, that there appears a publication in which there is crammed as many observations of tropical mammals as in the present report.

Enders has made 4 trips of considerable length to the Canal Zone, and during this time he has gained a greater knowledge of the mammals of Barro Colorado Island than any other white man, at least. Only one who has been on the island trails with him can

know the indefatigable zeal with which he has sought, day and night, elusive life history facts. The report is replete with information of this sort, and besides being a contribution of great importance, makes fascinating reading. There is discussion of the 66 sorts of mammals actually or probably occurring upon the island. In spite of the wealth of information presented one is impressed, as always, by the small amount that we actually know regarding life histories, and by the need for the encouragement of this sort of research.—A. B. H.

AHARONI, BATHSCHEBA. Die Muriden von Palästina und Syrien. Zeitschr. f. Säugetierkunde, Berlin, vol. 7, nos. 1–6, pp. 166–240, fig. 1, pl. 19. December 15, 1932. (New: *Apodemus (Sylvaemus) flavicollis pohlei, Meriones tamaricinus bodenheimeri, M. t. karjateni, Meriones erythrourus legeri, Arvicola terrestris hintoni.*)

AHLSTEDT, ERIC. Några ord om den ostafrikaniska Bongo-antilopen. Fauna och Flora, Uppsala, 1933, no. 4, pp. 163–166. 1933.

AMEGHINO, FLORENTINO. Formaciones sedimentarias de Patagonia. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 13, pp. 993, figs. 1932. (Edited by Alfredo J. Torcelli.)

——— Investigaciones de morfología filogenética en los molares superiores de los ungulados. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 14, pp. 619, figs. 631. 1933. (Edited by Alfredo J. Torcelli.)

——— Paleontología argentina: Relaciones filogenéticas y geográficas. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 15, pp. 5–91, figs. 72. 1934. (Edited by Alfredo J. Torcelli.)

——— Nuevas especies de Mamíferos cretáceos y terciarios de la República Argentina. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 15, pp. 93–218. 1934. (Edited by Alfredo J. Torcelli.)

——— La perforación astragaliana en los Mamíferos no es un carácter originariamente primitivo. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 15, pp. 219–329, figs. 98. 1934. (Edited by Alfredo J. Torcelli.)

——— La faceta articular inferior única del astrágalo de algunos Mamíferos no es un carácter primitivo. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 15, pp. 331–403, figs. 69. 1933. (Edited by Alfredo J. Torcelli).

——— Reemplazamiento de un nombre genérico. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 15, p. 405. 1934. (Edited by Alfredo J. Torcelli.) (*Sigmomys* preoccupied, changed to *Eusigmomys.*)

——— Presencia de la perforación astragaliana en el Tejón (*Meles taxus* Bodd.). Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 15, pp. 409–419, figs. 3. 1934. (Edited by Alfredo J. Torcelli.)

——— La perforación astragaliana en Priodontes, Canis (Chrysoción) y Typotherium. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 15, pp. 421–440, figs. 15. 1934. (Edited by Alfredo J. Torcelli.)

——— La perforation astragalienne sur quelques Mammifères du miocène moyen de France. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 15, pp. 441–465, figs. 12. 1934. (Edited by Alfredo J. Torcelli.)

——— La perforación astragaliana en el Orycteropus y el origen de los Orycteropidae. Obras completas y correspondencia cientifica de Florentino Amgehino, La Plata, vol. 15, pp. 467–507, figs. 32. 1934. (Edited by Alfredo J. Torcelli.)

AMEGHINO, FLORENTINO. Les Édentés fossiles de France et d'Allemagne. Obras completas y correspondencia cientifica de Florentino Ameghino, La Plata, vol. 15, pp. 577–685, figs. 61. 1934. (Edited by Alfredo J. Torcelli.)

——— Mi Credo. Obras completas y correspondencia cientifica de Florentino Amgehino, La Plata, vol. 15, pp. 687–727. 1934. (Edited by Alfredo J. Torcelli.)

ANDREE, JULIUS. Über diluviale Moschusochsen. Abhandl. Westfälischen Prov.-Mus. f. Naturkunde, Münster i.W., Jahrg. 4, pp. 5–34, pls. 12. 1933. (New: *Ovibos kahrsi*.)

ANTONIUS, OTTO. Beobachtungen an Einhufern in Schönbrunn. IX. Zur genaueren Kentniss des Wahlbergzebras (*Equus quagga wahlbergi* Poc.). Der Zoologische Garten, Leipzig, n.F., vol. 7, nos. 1–3, pp. 16–24, figs. 10. May, 1934.

——— Beobachtungen an Einhufern in Schönbrunn, X and XI. X. Zebroid und Maulesel. XI. Über den zweiten Schönbrunner Maulesel. Der Zoologischer Garten, Leipzig, n.F., vol. 7, nos. 7–9, pp. 165–179, illus. November, 1934.

ARAMBOURG, C. Les Ours fossiles de l'Afrique du Nord. Compte Rendu Somm. Séances Soc. Biogéogr. no. 74, année 9, pp. 29–32. May, 1932. (*Ursus arctos larteti, Ursus arctos faid-herbi, Ursus spelaeus minor*.)

ARGYROPULO, ANATOL J. Über zwei neue paläarktische Wühlmäuse. Zeitschr. f. Säugetierkunde, Berlin, vol. 8, nos. 3–6, pp. 180–183, figs. 3. December 20, 1933. (New: *Alticola* (*Alticola*) *semicanus alleni, Sumeriomys*, for *Microtus socialis* Pallas, *Microtus* (*Sumeriomys*) *colchicus schidlovskii, Blanfordimys*, for *Microtus bucharicus* Vinogradov.)

ARNDT, HANS JOACHIM. Zur Kenntnis der malazischen Knochenerkrankungen. (Befunde an Hund, Ziege, Fuchs, Löwe). Zeitschr. f. Säugetierkunde, Berlin, vol. 9, nos. 1–3, pp. 377–383, pl. 17. December 30, 1934.

BACHOFEN-ECHT, ADOLF FRH. Beobachtungen über die Variationsbreite von *Capreolus capreolus*. Zeitschr. f. Säugetierkunde, Berlin, vol. 8, nos. 3–6, pp. 184–194, fig. 1, pls. 16–20. December 20, 1933.

BARBOUR, ERWIN HINCKLEY, and C. BERTRAND SCHULTZ. A new Miocene dog, Mesocyon geringensis, sp. nov. Nebraska State Mus., vol. 1, bull. 43, pp. 407–418, figs. 192–197. May, 1935. (New: *Mesocyon geringensis*.)

BARBOUR, ERWIN HINCKLEY, and GEORGE F. STERNBERG. Gnathabelodon thorpei, gen. et sp. nov. A new mud-grubbing Mastodon. Nebraska State Mus., vol. 1, bull. 42, pp. 395–404, figs. 187–191. May, 1935. (New: *Gnathabelodon, G. thorpei*.)

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——— Mammiferi raccolti dal Museo di Storia Naturale della Venezia Tridentina in Trento durante gli anni 1930–31 (VIII–X). 3. Studi Trentini Sci. Nat., vol. 13, nos. 3–4, pp. 177–197. 1932.

BENSON, SETH B. Geographic variation in Neotoma lepida in Arizona. Occas. Papers Mus. Zool. Univ. Michigan, no. 317, pp. 9, fig. 1. July 1, 1935. (New: *Neotoma lepida flava*.)

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BOETTICHER, HANS VON. Bericht über die Säugetiere, die auf der Reise Königs Ferdinand von Bulgarien nach dem aequatorialen Afrika im Jahre 1929 beobachtet wurden. Izevestiia na Tsarskitie Prirodonauchni Instituti v Sofiia(Bull. Inst. Roy. Hist. Nat. Sophia-Bulgarie), vol. 4, pp. 51–60, figs. 7. 1931.

——— Ein weisser Tiger. Zeitschr. f. Säugetierkunde, Berlin, vol. 7, nos. 1–6, p. 258. December 15, 1932.

——— Die geographische Verbreitung der Robben (*Pinnipedia*). Zeitschr. f. Säugetierkunde, Berlin, vol. 9, nos. 1–3, pp. 359–369, figs. 2. December 30, 1934.

BOURDELLE, E. Les chats dorés d'Afrique et d'Asie. Compte Rendu Som. Séances Soc. Biogéogr., année 9, no. 78, pp. 66–70. 1932. (Marked difference between skull of *Felis temminckii* and skulls of most of the races of *Felis aurata* of Africa.)

BRAESTRUP, F. WIMPFFEN. Report on the mammals collected by Mr. Harry Madsen during Professor O. Olufsen's expedition to French Sudan and Nigeria in the years 1927–28. Vidensk. Medd. fra Dansk Naturh. Foren., vol. 99, pp. 73–130. September 11, 1935. (New: *Grammomys macmillani tuareg.*)

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BRAUER, AUGUST. Über die zur Unterscheidung der Arten der *Procaviiden* wichtigen Merkmale. Zeitschr. f. Säugertierkunde, Berlin, vol. 9, nos. 1–3, pp. 198–206, figs. 9. December 30, 1934.

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CHASEN, F. N. Three new Malaysian mammals. Bull. Raffles Mus., Singapore, Straits Settlements, no. 9, pp. 98–100. December, 1934. (New: *Rattus mülleri otiosus, Tragulus kanchil klossi, Lariscus insignis saturatus.*)

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DAMMERMAN, K. W. On prehistoric mammals from the Sampoeng Cave, central Java. Treubia, vol. 14, no. 4, pp. 477–486, pl. 11. December, 1934. (Among the mammals brought to this cave by prehistoric man are three now extinct in Java: *Bubalus bubalis, Elephas maximus* and *Cervus eldi?*)

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DUNBAR-BRANDER, A. A. The preservation of wild life in India. No. 1. The Central Provinces. Jour. Bombay Nat. Hist. Soc., vol. 36, no. 4, (suppl.), pp. 40–45. December 15, 1933.

EDINGER, TILLY. Harnsteine eines Höhlenbären. Palaeont. Zeitschr., Berlin, vol. 15, no. 4, p. 349–355, figs. 5. December 31, 1933.

EDSON, J. M. Yellow-bellied marmot at Bellingham, Washington. Murrelet, vol. 15, no. 3, p. 81. September, 1934. (*Marmota flaviventris avara.*)

EHRENBERG, KURT. Ein fast vollständiges Bärenskelett aus dem Alt-Diluvium von Hundsheim in Niederösterreich. Verh. zool. botan. Ges. Wien, vol. 83, Ber. Sekt. f. Paläont. u. Abstam., pp. 48–52. December 31, 1933.

——— Neue Beobachtungen zur Deutung der Knochenanhäufung im 'Abelgang' der Mixnitzer Drachenhöhole. Verh. zool. botan. Ges. Wien, vol. 83, Ber. Sekt. f. Paläont. u. Abstam., pp. 52–54. December 31, 1933. (Probably brought together by human inhabitants of the cave.)

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——— Fortpflanzungsgewohnheiten unserer heimeschen Fledermäuse. Naturforscher, Berlin, vol. 11, no. 8, pp. 265–270, figs. 6. November, 1934.

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——— Vergleichend biologische und psychologische Beobachtungen und Versuche an drei Meerkatzenartigen (*Cercopithecidae*) und einem schwarzen Brüllaffen (*Alouatta caraya* Humboldt). Zeitschr. f. Säugetierkunde, Berlin, vol. 9, nos. 1–3, pp. 164–187, pls. 9–22. December 30, 1934.

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——— Stachelig, grob-aber doch von echtem Schrot und Korn. Eine Ehrenrettung des Igels. Kosmos, handweiser für Naturfreunde (Gesell. der Naturfreunde), Stuttgart, Jahrg. 1932, no. 10, pp. 335–338, figs. 3. October, 1932. (*Erinaceus*.)

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——— Der technische Name des deutschen Rothirsches. Zeitschr. f. Säugetierkunde, Berlin, vol. 8, nos. 3–6, pp. 274–276. December 20, 1933. (The names *hippelaphus* Erxleben 1777 and *germanicus* Desmarest 1822 are "fixed" on the race from the Ardennes, *C. elaphus rhenanus* Matschie 1912.)

——— Der Gattungsname der afrikanischen Flussschweine. Zeitschr. f. Säugetierkunde, Berlin, vol. 8, nos. 3–6, p. 284. December 20, 1933. (Substitutes *Potamochoerus* for *Koiropotamus*.)

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——— Über einen Hybriden von Schweinsaffe (*Macaca nemestrina* Linnaeus) und Mohrenmakak (*Macaca nigra maura* F. Cuvier). Der Zoologische Garten, Leipzig, n.F., vol. 7, nos. 1–3, pp. 44–46. May, 1934.

——— Über einige von Th. Noack aufgestellte Namen für deutsche Muriden. Zeitschr. f. Säugetierkunde, Berlin, vol. 9, nos. 1–3, pp. 430–431. December 30, 1934. (*Mus spicilegus germanicus* Noack = *Mus musculus spicilegus* Petényi; *Mus sylvaticus discolor* Noack = *Rattus norvegicus* Erxleben.)

——— Der Hirscheber von Sula. Zeitschr. f. Säugetierkunde, Berlin, vol. 9, nos. 1–3, pp. 433–434. December 30, 1934. (*Babirussa babyrussa frosti* Thomas.)

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SEVERTSOVA, S. A. Sur la corrélation entre la durée de la vie et la fécondité chez différentes espèces de mammifères. Bull. Acad. Sci. URSS., ser. 7, cl. Sci. phys.-math., Leningrad, 1930, no. 9, pp. 931–950. 1930. (In Russian.)

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——— Beiträge zur Kenntnis Tertiärer Sirenen. I. Die Eozänen Sirenen des Mittelmeergebietes. II. Die Sirenen des Belgischen Tertiärs. Mém. Mus. Roy. d' Hist. Nat. Belgique, no. 63, pp. 1–352, figs. 52, pls. 11. December 31, 1934. (New: *Eotherium* (*Eosiren*) *abeli*.)

SIMPSON, GEORGE GAYLORD. Some Cretaceous mammals from the Lance Formation. Ann. Carnegie Mus., vol. 19, no. 2, pp. 107–113, figs. 6. May, 1929. (New: *Euangelistes*, *E. petersoni*.)

——— A collection of Paleocene mammals from Bear Creek, Montana. Ann. Carnegie Mus., vol. 19, no. 2, pp. 115–122, figs. 4. May, 1929. (New: *Labidolemur kayi*.)

——— The Tiffany fauna, upper Paleocene. III. Primates, Carnivora, Condylarthra, and Amblypoda. Amer. Mus. Novitates, no. 817, pp. 28, figs. 14. August 16, 1935. (New: *Carpolestidae*, *Thryptacodon australis*, *Phenacodus grangeri*, *P. matthewi*, *P. gidleyi*, *Periptychus superstes*.)

——— New Paleocene mammals from the Fort Union of Montana. Proc. U. S. Nat. Mus., vol. 83, no. 2981, pp. 221–244. October 18, 1935. (New: *?Ptilodus douglassi*, *?P. gidleyi*, *?P. sinclairi*, *?Ectypodus grangeri*, *?E. russelli*, *?E. silberlingi*, *?Parectypodus jepseni*, *Gelastops*, *G. parcus*, *Prodiacodon concordiarcensis*, *Leptacodon ladae*, *L. munusculum*, *Emperodon*, *E. acmeodontoides*, *Stilpnodon*, *S. simplicidens*, *Aphronorus*, *A. fraudator*, *Palaeosinopa diluculi*, *Eudaemonema*, *E. cuspidata*, *Palenochtha* for *Palaechthon minor* Gidley, *Claenodon vecordensis*,

Deuterogenodon, D. montanus, Prothryptacodon, P. furens, Chriacus pusillus, C. pugnax, Metachriacus, M. punitor, M. provocator, Spanoxyodon, S. latrunculus, Tricentes, T. latidens, Ictidopappus, I. mustelinus, Didymictis tenuis, D. microlestes, Tetraclaenodon symbolicus, T. superior, Gidleyina, G. montanensis, ?G. silberlingi, Ellipsodon aquilonius, Litaletes, L. disjunctus, Litomylus, L. dissentaneus, Haplaletes, H. disceptatrix, Pantolambda intermedius.)

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STEIN, GEORG. Einige neue Beuteltiere aus Neuguinea. Zeitschr. f. Säugetierkunde, Berlin, vol. 7, nos. 1–6, pp. 254–257. December 15, 1932. (New: *Dactylonax palpator ernstmayri, Phascogale maxima, Phascogale pan, Phascogale melas senex, Phascogale melas bürgersi, Echimypera clara, Microperoryctes, Microperoryctes murina, Pseudochirulus pygmaeus.*)

——— Weitere Mitteilungen zur Systematik papuanischer Säuger. Zeitschr. f. Säugetierkunde, Berlin, vol. 8, nos. 1–2, pp. 87–95, pl. 14. April 24, 1933. (New: *Pseudochirops albertisi insularis, Phalanger orientalis interpositus, Rousettus stresemanni, Pteropus pohlei, Macruromys, Macruromys elegans, Hyomys meeki dammermani.*)

——— Notizen zur Biologie papuanischer Säuger. Zeitschr. f. Säugetierkunde, Berlin, vol. 8, nos. 1–2, pp. 123–126. April 24, 1933.

——— Was sind *Peroryctes rothschildi* und *Peroryctes mainois?* Zeitschr. f. Säugetierkunde, Berlin, vol. 8, nos. 3–6, pp. 282–283. December 20, 1933.

STEPHEN, A. C. Cuvier's whale stranded in Argyll. Scottish Nat., no. 207, p. 86. May-June, 1934. (*Ziphius cavirostris.*)

——— Risso's dolphin stranded in Orkney. Scottish Nat., no. 207, p. 86. May-June, 1934. (*Grampus griseus.*)

——— White-beaked dolphin (*Lagenorhynchus albirostris*) stranded in Aberdeenshire. Scottish Nat., no. 210, p. 164. November-December, 1934.

STICHEL, W. Der Tierpark der Internationalen Pelzfach- und Jagdausstellung Leipzig 1930. Zeitschr. f. Säugetierkunde, Berlin, vol. 8, nos. 3–6, pp. 228–273, pls. 24–31. December 20, 1933.

STRELNIKOV, I. Physiological basis of the oecology of rodents. Sbornik VIZR'a, Vsesoiuznil Institut Zashchity Rastenil (Magazin der WISR'a, Inst. f. Pflanzenschutz Lenin Akad. landwirtschaftlichen Wiss.), Leningrad, no. 7, pp. 72–1933. (In Russian).

STREULI, ALFRED. Zur Frage der Artmerkmale und der Bastardierung vo nBaum- und Steinmarder. Zeitschr. f. Säugetierkunde, Berlin, vol. 7, nos. 1–6, 58–72, figs. 12, pls. 1–5. December 15, 1932.

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——— Instruction for the collection of materials on study and hunting of the arctic fox (*Alopex lagopus* L.). Vsesoiuzyni arkticheskii institute, PRI TSIK SSSR, Leningrad, no. 2, pp. 12. 1932. (Arctic Institute of USSR.)

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WESTERMEIER, (Inspector). Starkes Auftreten der Wühlmaus und deren Bekämpfung. Zeitschr. Pflanzenkrank. (Pflanzenpath.) u. Pflanzenschutz, Stuttgart, vol. 44, no. 11, pp. 556–558. November, 1934. (*Arvicola agrestris.*)

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ŽELIZKO, J. V. Zwei interessante Wirbeltiermumien. Paleont. Zeitschr., Berlin, vol. 14, nos. 1–2, pp. 122–126, figs. 2. May 31, 1932. (*Mustela erminea* and *Rattus norvegicus*. In houses.)

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——— Zum Vorkommen des Ziesels, *Citellus citellus* (L.), in Sachsen und Schlesien. Zeitschr. f. Säugetierkunde, Berlin, vol. 8, nos. 1–2, pp. 108–112. April 24, 1933.

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OBITUARY NOTICES

EDWARD M. BALL

Edward M. Ball, U. S. Bureau of Fisheries expert and a charter member of the American Society of Mammalogists, was born April 18, 1876, in Loudoun County, Virginia, and died November 30, 1935, in Georgetown University Hospital, Washington, D. C., after an operation for appendicitis. Mr. Ball, who resided at East Falls Church, Virginia, had been connected with the Bureau of Fisheries for 38 years. He was a well-known authority on Alaskan fisheries, and had written numerous articles on the subject. He was also an expert on fur seal skins and for a number of years represented the Bureau at its annual sales in St. Louis. After many years of service in the field he was assigned recently to the Washington headquarters of the Bureau.—VIOLA S. SCHANTZ.

HENRY FAIRFIELD OSBORN

Henry Fairfield Osborn died from a heart attack at his home in Garrison, New York, on November 6, 1935. He was born in Fairfield, Connecticut, on August 8, 1857, the son of Virginia Reed (Sturges) and William Henry Osborn, president of the Illinois Central Railroad. His early education was received at the Columbia Grammar School and Lyons Collegiate Institute. After graduating from Princeton University in 1877, he pursued his studies at the Royal College of Science, London, and at Cambridge. Honorary degrees were awarded to him by Trinity College (1901), Princeton University (1902), Cambridge University (1904), Columbia University (1907), University of Christiania (1911), Yale University (1923), Oxford University (1926), New York University (1927), Union College (1928), and the University of Paris (1931).

In September, 1877, Osborn began paleontological research at Princeton. During the years that followed he published nearly a thousand articles and memoirs, the most substantial of which dealt with vertebrate paleontology. Beginning in 1881, when he was appointed assistant professor of natural science at Princeton, and during the period of his professorship of comparative anatomy at the same university (1883–1890), his interests were about equally divided between anatomy and vertebrate paleontology. Many mammalogists are unaware of his outstanding contributions to neurology. He was called to Columbia University in 1890 as Da Costa professor of biology, a position that he held until 1910. In 1891, Professor Osborn was appointed curator of vertebrate paleontology in the American Museum of Natural History; he was subsequently made its president (1908–1932). In addition to his other activities he served as vertebrate paleontologist on the Geological Surveys of the United States (1900–1924) and of Canada (1900–1904).

Among his best known works are "From the Greeks to Darwin" (1894), "The Age of Mammals" (1910), "Men of the Old Stone Age" (1915), "The Origin and Evolution of Life or the Theory of Action, Reaction, and Interaction" (1917), "Evolution and Religion" (1923), "The Titanotheres of Ancient Wyoming, Dakota, and Nebraska" (1929), and "Cope: Master Naturalist" (1931). He directed exploration on a large scale in Egypt, Samos Island, northern India, the Gobi Desert, and the western United States.

During the past few years, he was engaged in the preparation of a comprehensive monograph on the Proboscidea. For more than fifty years Professor Osborn worked as educator, curator, author, and administrator, always with unflagging enthusiasm.—R. K.

SIGURD RISTING

Sigurd Risting, secretary of the Association of Whaling Companies since 1918 and editor of the Norwegian Whaling Gazette, died at Sandefjord, Norway, on October 14,

1935. He was born on May 13, 1870, at Kinn, Sunnfjord, Norway. During the past 15 years, Risting was actively engaged in compiling and publishing statistical information in regard to the whaling industry. In the autumn of 1919, he began his statistical investigation of whale populations to throw some new light on the relation between stocks and catches. In 1929 Risting, Gunnar Jahn, and Professor Johan Hjort were appointed members of the Committee for Whaling Statistics by the Norwegian Government. This committee published five reports on "International Whaling Statistics" (1930–1934). Two of the more important contributions of Risting to cetology are "Av Hvalfangstens Historie" (1922) and "Whales and whale foetuses" (1928).—R. K.

HARRY SCHELWALD SWARTH

The death on October 22, 1935, in Berkeley, California, of Harry Schelwald Swarth removed from the rolls of the American Society of Mammalogists one of its charter members as well as one of the most active and widely respected workers in vertebrate zoology on the Pacific coast. He was born on January 26, 1878, and spent his early life in Chicago and Los Angeles. His interest in nature was aroused and fostered by his early close association with Mr. George Frean Morcom. Swarth was Assistant in the Department of Zoology, Field Museum of Natural History (1904–1908). When the California Museum of Vertebrate Zoology was established in 1908, he joined the staff as Assistant Curator of Birds. From 1910 to 1927, he was Curator of Birds, except for an interval (1913–1916) as Assistant Director, Museum of History, Science and Art, Los Angeles. In 1927, he became Curator, Department of Mammalogy and Ornithology, California Academy of Sciences. He held that position until his death.

Swarth's zoological explorations covered a period of nearly 40 years and extended to several regions in western North America, including Arizona, southern California, southeastern Alaska, and the coastal portion of British Columbia. He was in charge of the scientific staff of the Templeton Crocker Expedition of the California Academy of Sciences, 1932, which visited the Galapagos Islands. Although his published work dealt mainly with faunal and systematic ornithology, his reports also covered the mammals. At least twelve of his papers dealt wholly or in part with mammals. He described 9 kinds of mammals and 2 more with J. Grinnell. A kangaroo rat, *Dipodomys heermanni swarthi* (Grinnell), was named in his honor in 1919.—JEAN M. LINSDALE.

FRANKLIN JAMES WHITE SCHMIDT

Franklin James White Schmidt, a member of the American Society of Mammalogists and Research Assistant in the Department of Game Management at the University of Wisconsin, died in a fire which destroyed the home of his parents near Stanley, Wisconsin, August 8th, 1935. He was born at Lake Forest, Illinois, July 25, 1901, the son of George W. and Margaret Patterson Schmidt. Brought up on the farm in Worden Township, Clark County, Wisconsin, to which the family moved in 1907, he exhibited, as a child, an active interest in natural history, and there became an accomplished woodsman.

His secondary education was delayed by illness and accident, and he did not enter the University of Wisconsin until 1926. His degree of Bachelor of Arts was received in 1930. During the summer of 1930 he assisted Dr. Alfred O. Gross in investigations on the status of the prairie chicken and sharp-tailed grouse in Wisconsin, and so became acquainted with the territory at Babcock, in Wood County. This locality became the base for his studies on game birds during the following 5 years, under the auspices of the Department of Conservation of Wisconsin and of the Department of Game Management of the University.

During the years 1924, 1925, and 1926 he assisted in the Divisions of Reptiles and Birds at Field Museum of Natural History, and while there became actively interested in

mammalogy. During his college years he engaged in field studies on mammals in Clark County, Wisconsin, which were reported in one of his few papers, published in the Journal of Mammalogy.

In 1933–1934 he acted as the mammalogist of the Mandel Guatemala Expedition of Field Museum. His collections included specimens of new rodents and bats, and such rarities as the epaulet bat, *Centurio senex*, and the Guatemalan flying squirrel.

At the time of his death he had in preparation two series of papers, dealing with the life-history of the sharp-tailed grouse and with the game cycle as exhibited in small mammals. For the study of the latter problem he devised a special system of live-trapping and marking.

Wholly absorbed in his work and in aiding others interested in similar and related fields, he was slow to publish, and his reputation is confined to a small circle of intimate friends who saw in him an ideally equipped field naturalist, cut off at the threshold of a great career.—K. P. Schmidt.

COMMENT AND NEWS

The editor has before him a copy of a report by the late E. W. Nelson entitled "Bats in relation to the production of guano and the destruction of insects" (U. S. Dept. Agric. Bull. no. 1395, 12 pp., 1926). It was written by a man who had an intimate knowledge of his subject throughout many long years. As one reads he is impressed by the fact that here is a mammal wholly beneficial, totally inoffensive, and one against which man's hand can never with justification be raised, except in ignorance and prejudice.

Beside it, in contrast, is another leaflet, received as we go to press. It is entitled "Eliminating bats from buildings" (Silver, J., U. S. Dept. Agric. Leaflet no. 109, 5 pp., 1935). In all fairness it must be emphasized that in this it is mentioned that bats are not only useful but harmless as well, and that their killing is advocated as a last resort; but the defense of these mammals is rather half-hearted. The opening paragraph is headed "Objections to Bats," and half the leaflet is devoted to neutral or derogatory statements by which the reader is led to believe that this is an objectionable animal, with redeeming features, it is true, but still objectionable. The lamentable feature is the approach to the whole question. There is neither mention of the fact that a mammal economically so valuable should not be killed, nor of the circumstance that fumigation will afford but temporary relief, for other bats will be attracted for years and years to a roost once occupied. The only proper way to drive bats from a building when their presence proves objectionable is to board up their entrances, leaving a hole to which is attached a wire funnel allowing egress but preventing entrance. No such device, by the use of which no bats need be killed, is accorded consideration.

In the Denver Post on December 8, 1935, appeared an item entitled "Colorado may be stocked with 500 Belgian hares." In this it was stated that Colorado cottontails are going the way of the buffalo and the time has come to consider a conservation plan, so Belgian hares are proposed by local hunters for replacement of the rabbits. The scheme is alleged to have the support of R. G. Parvin, states game commissioner. Members of the American Society of Mammalogists who learn of ill-considered and dangerous proposals of this sort emanating from their home states should make every effort to prevent them. If Belgian hares be liberated and a few of them survive and multiply, Colorado would have, in effect, two jack-rabbit problems, with nothing but undesirable results. If cottontails become scarce in a district where formerly they were abundant the logical diagnosis is either overhunting or, in the case of a western state, poison.

Rabbit hunting cannot prosper where there are state-wide poison campaigns against rodents.

The American Society of Mammalogists has been fortunate in having had, since its inception, editorial talent of a high order. The standard thus set, at unselfish cost in time and patience, will not be perpetually maintained without effort. That it can be improved is unlikely.

The new editorial committee, now functioning, entertains, nevertheless, an ambition to improve the JOURNAL OF MAMMALOGY. It is possible to accomplish this only in two ways—by enlarging the JOURNAL, and by improving the quality of its contents. Enlargement may be effected by an increase in the membership of the Society, which is not within the province of the editors; or by securing subsidies for a proportion of the articles published. Those authors able to do so can perform no higher service to the Society than to contribute to the cost of their articles. This is particularly the case in regard to half-tone illustrations, of which only a very limited number can be undertaken without subsidy.

The editors can publish only what is sent to them; hence improvement in the quality of articles rests with the authors. It is hoped that the latter will submit their very best efforts for publication in the JOURNAL.

The JOURNAL OF MAMMALOGY subserves two functions. One is to furnish papers of interest and value to the membership at large. The other is to furnish a medium for publication, chiefly for the type of papers in the field of mammalogy for which there is not already a suitable outlet.

It is the aim of your editorial committee to please the greatest number of members. If there is received an unduly large proportion of papers on paleontology, taxonomy, genetics, anatomy, or some other technical phase of mammalogy, some of them must be rejected, regardless of quality. A certain percentage of such technical papers is desirable, but in the majority of cases they can be so composed as to be of interest to the non-technical reader without appreciable sacrifice of quality. Similarly, papers can be too "popular" for the JOURNAL. Publications should make some definite contribution to our knowledge, and not be merely nature essays.

In the immediate future the policies already established for the JOURNAL will be followed. Manuscripts received will be promptly acknowledged, and the authors notified of acceptance or rejection as soon as is feasible. All authors will have the privilege of examining their edited papers providing they will pay the necessary postage. Galley proof will be sent all authors, except those living in foreign countries. Changes from copy made on galley proof, with the exception of those obviously needed, must be paid for by the author. This rule is necessary, because the insertion of even a comma in galley proof costs twenty-five cents, and the interpolation of a short word, several times that sum. The JOURNAL belongs to the members, and should be conducted for them, rather than for the individual author.

The proper preparation of manuscript materially lightens editorial labors. Directions for preparation are printed on page 88 of the JOURNAL for February, 1935.

THE EDITORIAL COMMITTEE.